REPORT OF THE INTERDEPARTMENTAL STUDY GROUP ON OCEAN INFORMATION SYSTEMS

Philip A. Lapp Limited

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Prepared By

Dr. Philip A. Lapp

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EXECUTIVE SUMMARY

In September, 1977, the Ad Hoc Committee of Ministers on Ocean Management instructed the Panel on Ocean Management to:

> "carry on the task of designing an integrated ocean information system for the future, including initiating interdepartmental efforts to review major program data acquisition systems now contemplated or under development, to establish and to coordinate the program data needs of departments in this area (given ocean management requirements) in order to facilitate the multi-tasking of those new program data acquisition systems, and to define the program data handling capabilities (storage, processing, dissemination) that will be required in that context."

MOSST was asked by the Panel to respond to this instruction. Subsequently, in January, 1978, MOSST received approval of the Panel and the Committee of Ministers for the "Interim Report on the Design of an Ocean Information System", which outlined the objectives and terms of references for a proposed interdepartmental study. This study was also to address an additional request to MOSST from the Surveillance Satellite Review Board for a "general evaluation of ocean surveillance systems".

An interdepartmental study group, with representation from all departments with responsibilities for ocean management operations, technology development and policy formulation, was established under the chairmanship of Dr. Philip Lapp, a consultant retained by MOSST. This report presents the results of the study group's analysis.

The study group, following the basic conceptual framework of the 1976 "Overview Report" of the Panel on Ocean Management, assembled an inventory of ocean data needs and systems under the following seven management functions:

Renewable Resource Management
Non-renewable Resource Management
Protection of the Marine Environment
Development and Control of Navigation
Defence
Ocean Service Activities
International Ocean Management

In some instances, departmental mandates span more than one management function, and, conversely, certain functions are performed by more than one department. The report examines departmental ocean management activities, the needs for data, how such data is acquired and processed, and how departments inter-relate to perform the management functions listed above.

The study group found that, with some exceptions, the information needs of departments are generally being met. Near-term problems identified in the study relate to continuity in the provision of suitable surveillance platforms - the replacements for the Tracker and ice reconnaissance aircraft now approaching the end of their useful lifetime, and for the ships serving Ocean Station Papa in the Pacific which will be withdrawn from service within the next two years.

Longer-term problems relate to the ability of the government to respond to major possible events that could cause significant expansion in ocean information requirements in the 1980's:

- expansion of offshore exploration leading to oil and gas development and production,
- the transport by sea of significant quantities of oil and gas out of the arctic, and
- increased domestic offshore fisheries activities, particularly in ice-infested waters.

The study group has found that problems are beginning to arise associated with the planning and funding of R and D, when more than one department is involved. No one group is responsible for assembling the data requirements that presage the need for new or improved data acquisition and handling systems, nor are the necessary cost effectiveness studies being pursued adequately. It was also learned that planned U.S. space policies could magnify the difficulty of receiving current data received by U.S. resource and oceans-related satellites, and could thus render Canada's resource satellite receiving stations obsolete.

There is no single integrated ocean information system and there currently appear to be no compelling reasons for further significant integration of existing systems. However, the common use of certain data acquisition platforms such as the Tracker aircraft does occur, and it is probable that this phenomenon will tend to increase with the development of new high cost data acquisition techniques. The study group received no evidence of serious duplication, and departments appear to be satisfied with linkages between their respective systems which the study group found to be quite effective, though often informal.

On the basis of its findings, the study group recommends that a mechanism be established or identified to carry out on a continuing basis an integrated interdepartmental ocean information planning function to:

a) continually assemble and monitor user needs (federal, provincial and municipal governments and industry) and identify gaps that need to be filled,

b) plan future ocean systems facilities in response to needs,

c) perform cost effectiveness studies on how new technologies can reduce costs and improve efficiencies in accomplishing current and future mandated management functions,

d) identify necessary R and D, and arrange for it to be done by government or industry using government technology agencies for advice and scientific program monitoring,

e) examine and take the necessary action to ensure needs are being met for technological requirements that tend to fall between mandates, such as communications and data transmission facilities,

f) monitor and audit foreign technology development programs,

g) identify long-range opportunities for the ocean information supply industry,

h) recommend suitable mechanisms for multi-departmental funding for major capital procurements,

i) establish and help to maintain standards for archival data collection, handling and storage, and

j) encourage the establishment of an ocean information referral service.

ACKNOWLEDGEMENT

The writer wishes to acknowledge the hard work and faithful support provided by the study group's secretary, Dr. Michael E. Smith of MOSST, supported by Mr. Paul Beaulieu. In addition to coordinating meetings, briefings and field visits, they assembled and prepared the wealth of surveillance requirements material appearing as Appendix 2, and collected much of the basic data needed to prepare the report. The writer is most grateful for their efforts.

TABLE OF CONTENTS

1. INTRODUCTION

1.1 History

In September, 1977, the ad hoc Committee of Ministers on Ocean Management instructed the Panel on Ocean Management to:

> "carry on the task of designing an integrated ocean information system for the future, including initiating interdepartmental efforts to review major program data acquisition systems now contemplated or under development, to establish and to coordinate the program data needs of departments in this area (given ocean management requirements) in order to facilitate the multi-tasking of those new program data acquisition systems, and to define the program data handling capabilities (storage, processing, dissemination) that will be required in that context."

An Interim Report was prepared by MOSST on the Design of an Ocean Information System, dated January 26, 1978. Approved by the Panel on Ocean Management (POM) and the Committee of Ministers, it developed objectives for an ocean information system design study based on a conceptual framework outlined in the earlier Overview Report of the POM, dated July, 1976. A Progress Report was prepared for MOSST in July, 1978, and the present document is the final report submitted to fulfill the need for a design study on ocean information systems.

A recent report by D. J. Clough* traces the history of Canada's concerns over ocean management from the 1958 Continental Shelf Convention to the establishment in 1977 of a fisheries zone out to 200 miles from shore. It describes the parallel evolution of government management structures leading to the formation of the Panel on Ocean Management in April, 1976,

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* Clough, D. J., Ocean Observation Systems Related to Design of an Integrated Ocean Information System, Jan. 6, 1979, a report submitted to the MOSST Study Group on Ocean Information Systems - Ref. 1.

and the establishment in 1977 of a three-year surveillance satellite (Sursat) program under the policy direction of an interdepartmental Sursat Review Board. The Sursat program is concerned principally with Canada's involvement in evaluating the US Seasat satellite with a view toward assessing the feasibility of a Canadian surveillance satellite. As part of this assessment, the Review Board requested MOSST "to conduct a general evaluation of surveillance systems for both sea and land, with particular emphasis on Seasat". The Clough study addresses oceans-related aspects of the general evaluation, but detailed assessments of Seasat-A - a satellite launched June 26, 1978 which ceased operating on October 9, 1978 - will not be completed until late in 1979. The current report draws on the Clough study, and integrates the oceans aspects of the Review Board request with the POM design study.

1.2 Factors

New management responsibilities arising directly from Canada's establishment of a fisheries zone out to 200 miles from shore, and the expanding activities in ocean and seabed resource exploitation with concurrent environmental hazards are expected to result in increasing demands for oceans related information. At present there is no single "oceans information system". Instead there are a number of separate management activities grouped under seven national management functions:

- renewable resource management
- non-renewable resource management
- protection of the marine environment
- development and control of navigation
- defence

- international ocean management (the exercise of all other ocean management functions in areas beyond coastal state jurisdiction).
- ocean service activities (providing the infrastructure upon which the entire ocean management regime rests).

While some management activities span several departments, others are contained entirely within a single department or agency, including the supporting information system. Thus, while there is no single "system", there are a variety of system components owned and operated by individual departments or agencies in support of the above ocean management functions.

Most information systems supporting management activities contain two basic groupings of components:

Data Acquisition Facilities	-	including platforms and sensors.
Data Handling Facilities	-	including communications, computer, processing, storage and retrieval facilities.

Such components will have to cope with expanding volumes of data as Canada grasps a firmer grip on the management of its oceans and in the exercise of its sovereignty in the far northern reaches. As the demand on some components increases, the cost of going separate ways may become prohibitive and the pressure for departments to share information facilities will increase.

For example, pressures now are being experienced for the sharing of data acquisition platforms such as satellites, aircraft and ships. Sensors mounted on such platforms can provide data needed by a variety of management activities. Seasat was a typical case - the forerunner of a possible future series of US satellites. It carried a radar that could penetrate cloud cover and darkness, and thus provide all-weather surveillance of certain environmental parameters and human activities such as ice and shipping.

The introduction of such sophisticated sensors will give rise to very high data rates that could overload the rest of any information system very quickly. Communications, computer, data processing and storage facilities must, of necessity, add capacity and become increasingly complex to cope with the throughput of data resulting from the new sensors. While the sheer volume of data is expected to expand enormously with new technology, the information derived from it and conveyed to the user must remain finite and manageable for it to be of any use.

Thus the design of an ocean information system involves establishing a means of identifying individual user needs and then selecting whatever technology is required to fulfill such needs with a minimum of cost, duplication and complexity. However, the design must also take into account the organizational arrangements through which Canada exercises its oceans responsibilities.

1.3 Terms of Reference

As stated in the Interim Report, the ocean information system design study consists of three tasks:

1. Identification of the present and anticipated data requirements of departmental, and perhaps non-governmental, programs that should be considered as part of the study.

2. Review of major data acquisition and handling (including storage, processing, information dissemination) systems, including existing facilities, those under development and those contemplated over the next decade.

3. Determination of possible technical and management options in the matching of data acquisition and handling technologies (identified in (2) above) to the program data acquisition requirements (identified in (1) above) in order to allow Canada to meet its ocean management objectives for the 1980s. This task will include an evaluation of both the potential for common record keeping for programs with overlapping data requirements and also the possibility of multi-tasking of computer facilities.

In addition, there is the request of the Sursat Review Board to conduct a general evaluation of surveillance systems which was to include an estimate of future surveillance requirements, a summary of existing ocean surveillance systems, and assessments of cost effectiveness of different system mixes in meeting surveillance requirements.

For purposes of the study, the term "oceans" embraces all saline waters touching mainland Canada including the Gulf of St. Lawrence and the arctic archipelago. It does not include inland waters and the Great Lakes except where it is unnatural or senseless to divide a management activity between oceans and inland waters.

1.4 Study Objectives

The primary objective of the study has been stated to be the design of an integrated ocean information system that will be in place in the 1980s. Such an objective implies a single, all-embracing system under one management serving the information needs of different users in the various departments and agencies with ocean management responsibilities. No such assumption has been made by the writer. Instead, existing individual information systems serving the seven management functions listed above are taken as the starting point for analysis. The primary objective then becomes one of establishing the type and degree of integration desirable in future - where and how such integration should be planned and put into effect.

Specific objectives of the study are as follows:

a) The question of centralization or degree of integration can be addressed effectively only when the persons involved in the analysis have been exposed directly to the information systems under study. Thus heavy stress has been placed on field visits by the study group to experience first hand the operations of real-time on line systems in the ocean management regime, and to provide the opportunity of interviewing operations personnel.

b) New technology will make certain management activities feasible that were heretofore not possible. For example, the remote sensing of ice floes in arctic waters under all-weather conditions can aid in safe and efficient navigation for shipping frontier oil and gas to market. Such applications may not yet appear as specific needs, and it is a purpose of the study to make potential users aware of the possibilities, and of how new technologies can assist in performing present management tasks more efficiently. Equally, it is important that information system design be based on real user needs, and not be simply technology-driven. The study attempts to strike an appropriate balance between technological possibilities and stated user needs.

c) New technology will vastly expand information throughput in future systems, with concurrent increases in cost and complexity. Thus a major objective of the design study is to establish the minimum amount of information needed by users to perform their current and future ocean management activities effectively.

d) Data requirements of information systems usually are expressed in terms of parameters that must be measured or determined in order to provide the information needed by the user or manager. For example, vessel position is a parameter needed for vessel traffic management. The identification of such parameters for the seven management functions listed above is an important objective of the study.

e) Current ocean information systems are highly decentralized, and thus it is quite possible that duplication is occurring either in data acquisition, or in data handling activities or facilities. An objective is to examine for such duplication and form a judgement as to whether there are more cost effective alternatives.

f) While the platforms and sensors tend to dominate the rest of the system, other components need to be examined because of the economies that might be gained through multi-tasking and new technologies. For example, the distribution of wide-band communications, localized processors and storage media is a major element of the system design process. Whether or not there is merit in sharing such system components among several management activities, and whether or not there is value in tasking a single "utility" for all or most of the information needs of ocean management are important issues of the study. Problems of inter-departmental financing, procurement and operation thus will need to be addressed where there is likely to be a sharing or multi-tasking of facilities.

g) It is an objective of the study to draw out and highlight problems associated with research and development, and the coupling of R and D with long range planning so as to ensure that the R and D is directed toward the meeting of user needs. A further objective is to identify opportunities for Canadian secondary industry - particularly where R and D can place industry in a technological leadership position for meeting Canadian and international needs.

h) Because certain platforms such as satellites and aircraft provide coverage of land as well as ocean areas, there is a need to link information systems across the land-ocean interface. However, until a land surveillance systems study is conducted, it is only possible to examine linkages with land systems that presently exist. For example, the Atmospheric Environment Service (AES) operates a complex information system spanning the land-ocean interface.

1.5 Method of Approach

In order to perform the study tasks, an Ocean Information Study Group was established under the chairmanship of Dr. Philip A. Lapp, a consultant under contract to MOSST. Dr. Michael E. Smith of MOSST was secretary of the study group, supported by Mr. Paul Beaulieu. The study group consisted of representatives from departments and agencies that perform ocean management functions, or provide services that support these functions. The group also included members possessing special technological expertise - from the Department of Communications, the National Research Council and the Canada Centre for Remote Sensing. A representative from the Department of Industry, Trade and Commerce was a member of the study group whose role was to identify opportunities for Canadian industry early in the design stages. A representative of the Sursat Program Office was assigned to provide liaison between the two groups. Because of the organizational, interdepartmental and financial implications of the project, representatives from the Privy Council Office, the Department of Finance and the Treasury Board Secretariat also were members. A list of all study group members appears in Appendix 1.

Reporting periodically to a sub-group of the Panel on Ocean Management which has acted as a steering committee for the project, the study group held a total of 13 meetings over the period March 16, 1978 to March 31, 1979, during which it received briefings and written descriptions from agencies with ocean information interests and concerns. Field visits were conducted at relevant facilities in Ottawa, Toronto and the Halifax-Dartmouth region. The east coast visit was particularly important to the study group because of the instruction from the ad hoc Committee of Ministers on Ocean Management that "sea and air operations personnel should be involved in any aspects of this study which interface with the operational control of vessels and aircraft". Meetings of the study group, visits and briefings received are summarized in Appendix 1.

During the period between March 16th and July 6th, 1978, when the Progress Report was issued, the group focussed on Tasks 1 and 2 in the Terms of Reference. Both tasks involved essentially the preparation of an inventory of existing and planned information systems supporting ocean management activities, and the physical quantities or parameters that are handled by such systems. The initial four months was a period during which study group members became familiar with the ocean management activities of other departments and agencies with ocean responsibilities.

In order to complete the inventory, and as a specific response to the Sursat Review Board's request, the ocean surveillance requirements originally compiled in 1976 for the Satellites and Sovereignty study* were updated. The system inventory and surveillance requirement update are combined in Appendix 2.

The period between July, 1978 and March, 1979 was devoted to Task 3 in the Terms of Reference - the analytical phase - which essentially involved the examination of a range of

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* Report of the Interdepartmental Task Force on Surveillance Satellites, August, 1977 - Ref. 2.

technical and management issues in the matching of systems to needs. During this period, it was found necessary to establish a special working group on archival systems. Such systems tended to get neglected by the study group as a whole because of its preoccupation with problems associated with the major, real-time, on line systems. The report of the archival working group appears as Appendix 3.

Finally, as referred to earlier, the Clough report on Ocean Observation Systems dated January 6th, 1979, is an important source document written in support of the study group and its obligation to the Sursat Review Board to conduct a comparative evaluation of surveillance systems.

1.6 Summary

The following section of the report deals in turn with each of the management functions listed earlier, and describes the relevant activities and information systems. It examines both present and future data needs and details problems foreseen by those interviewed. The purpose is to provide an overview of the entire ocean management regime and the needs for information.

Issues related to data acquisition and handling facilities are the subject of the third section which focusses on most of the critical areas highlighted during the study. A section on findings follows, summarizing without editorial comment the essential facts uncovered during briefings and visits as they relate to the objectives outlined earlier.

In the fifth section, conclusions are drawn from the findings and critical issues. A single recommendation flows from the conclusions.

2. OCEAN MANAGEMENT FUNCTIONS: DATA NEEDS AND SYSTEMS

Ocean management has come to mean the management of resources in and under the oceans, the supervision and management of traffic on and in the oceans, and the monitoring and protection of the marine environment. It is convenient to subdivide the ocean management regime into seven management functions to be described below. Within each function there are management activities needing data or information. The following paragraphs describe the activities within each management function, and the information systems supporting them. The focus is on present and future data needs, and whatever problems or issues have been uncovered by the study group through briefings and field visits.

2.1 Renewable Resource Management

2.1.1 General

The essential management activities under renewable resources relate to fisheries management, and include:

a) The Conservation of Fish and the Protection of Fish Habitats

- resource and stock assessment and associated biological research.
- habitat protection including enforcement of regulations, environmental assessment and associated research for these activities.
- management and operation of vessels and other platforms for biological research.

b) <u>The Allocation and Control of Access to Fishery Resources</u>

- enforcement of fishing regulations, offshore surveillance, and application of quotas.
- entry control/licensing programs.
- management and operation of vessels and other platforms for surveillance.

In January 1977, under the Territorial Sea and Fishing Zones Act, the government passed an Order-in-Council extending Canadian fisheries jurisdiction from 12 to 200 miles from shore. This, together with subsequent actions, permitted Canada to gain control of the management and exploitation of renewable resources over an additional 700,000 square miles of ocean space, south of the Arctic Circle. The new management regime requires that the Department of Fisheries and Oceans (DFO) be responsible for establishing the total allowable catch (TAC) for each stock, and determining the portion of the TAC to be reserved for the Canadian fishing industry. Canada then determines the allocation of any surplus among foreign states. After two years under the new regime, visible results include:

a) an indication that some stocks are recovering;

b) a reduction in the share of offshore resources allocated to foreign fishing vessels, and,

c) a greatly improved domestic fishery.

For certain species, stock recovery is expected to be complete during the 1985-1990 period. Canadian fishing fleets should thus continue to expand their catches. At the present time, fishing effort is concentrated on the continental shelf regions but, as the Canadian fishing fleet improves, the exploitation of renewable resources is likely to be extended into new areas - particularly in the Hamilton Banks and northward up the Labrador coast.

In addition to DFO activities related to fisheries, the Canadian Wildlife Service (CWS) carries responsibilities for ocean areas. Under the Migratory Birds Convention Act, CWS is responsible for conservation of the seabird populations which either breed on Canadian territory or use the ocean areas included within the 200-mile limit. The task entails the documentation of statistics concerning seabird populations and the harmful effects of pollutants.

Under the agreement on the Conservation of Polar Bears between Canada, Denmark, Norway, USSR and USA, the CWS is responsible for ensuring Canadian adherence to the terms of the agreement. This involves research to establish relevant statistics and the setting of hunting quotas.

2.1.2 Data Needs

Research activities are an important aspect of fisheries management. Much of the activity in fisheries research is directed towards plankton surveys, fish inventories (including surveys of larval stages), tag recovery studies and the assessment of population parameters (mortality rates, growth rates). This information, together with the information obtained from the sampling of commercial catch, is used to monitor the trends in fish stocks and constitutes an important tool for the management of Canadian fisheries. Information needed on a systematic basis includes catch volumes, catch rates, catch composition (age-frequency distribution, age-length keys, growth parameters), abundance estimates and tag recovery data. In addition, the importance of biological research (life-histories, stock identification) is evident. For research purposes, there is an increasing need for stock assessment and stock interaction data, as well as for information on the impact of environmental and oceanographic parameters on stocks.

In order to administer the licensing programs, to assist in the surveillance operations and to ensure quota compliance, DFO has established an on-line, real-time database management system known as FLASH - the Foreign Fishing Vessels Licensing and Surveillance Hierarchical Information System. It meets the needs for data input, inquiries and report generation arising from the extension of fisheries jurisdiction. It is national in scope, combining inputs and providing services to Newfoundland, Maritime and Pacific regions and Fisheries Headquarters in Ottawa.

FLASH provides daily updates on foreign fishing information, and daily exception reports that point out discrepancies and violations. Details of FLASH may be found in Appendix 2, p. 2-17.

In the near future, it is likely that the data being collected formally for foreign fishing vessels may be extended to domestic fleets in order to manage stocks more effectively. The major need at present and in future is to assure there is sufficient surveillance both from aircraft and from ships to form a deterrent to would-be violators of the regulations.

The fishing fleets themselves need information and services for safety reasons. These include data on weather, sea state and ice, reliable communications and, for vessels in distress, marine emergency response.

2.1.3 Data Acquisition and Handling

a) Data Acquisition

Within the area of extended jurisdiction, resource surveys are performed by departmentally-owned research vessels. Short-term and long-term charters are also used to complete DFO requirements regarding vessel time. Two new stern research trawlers should enter into operation on the east coast by 1981.

Surveillance data form the major dynamic inputs to FLASH. DFO establishes surveillance guidelines for DOT and DND, which assist with sea and air patrol functions. Surveillance from vessels is performed by DFO, DOT and DND. Also DFO places observers directly on foreign ships. More details are provided in Appendix 2, p. 2-17.

Aircraft surveillance is performed principally by DND Tracker with additional coverage by DFO chartered aircraft and DND Argus patrols. In 1978 approximately 4000 hours of dedicated Tracker time was devoted to fisheries surveillance - 1130 hours from Nova Scotia, 2030 hours from Newfoundland and 840 hours from B.C. In addition, a total of 722 hours of multi-tasked Tracker time was shared with DND. Argus aircraft are used to cover more distant fishing grounds off Newfoundland and the Labrador coasts, in the Davis Strait and off the Pacific coast. A total of 70 Argus trips were used for fisheries surveillance in 1978.

Tracker/Argus crews provide their data to Maritime Headquarters and thence to DFO through formatted post-flight reports which need to be transcribed before the data is entered into FLASH. Earlier delays in entering reports now are reduced; the objective is to have 95% of all sighting reports entered within 2 days.

No changes appear to be necessary in the short term relating to the integration of present technology or organization to increase surveillance effectiveness. There is no plan to link electronically DND or DOT platforms and/or information centres to FLASH. Also, there is no plan yet on paper to install "black boxes" on fishing vessels for surveillance purposes - an electronic device to aid in locating and keeping track of fishing fleets by transmitting ship position and an identifying code.

Over the longer term, DFO is investigating the feasibility of using airships to support surveillance and other DFO activities. Also, there is a continuing interest in the various satellite programs and the role they could play in fisheries surveillance - particularly satellites with radar for penetrating cloud cover, fog and darkness. DFO also has stated there is a need to improve communciations with patrol vessels.

b) Data Handling

Scientific fisheries data are processed in St. John's, Halifax, St. Andrews, Vancouver and Nanaimo. The vast majority of such data is archival, is not organized using database management software, and is not maintained on-line. Data is stored in sequential files (magnetic tapes). Retrieval is performed by standard batch programs.

For the foreign fleet, the information on licensing, allocation, catch and effort is kept in FLASH. The main users are regional personnel involved in the daily operations of managing the extension of fisheries jurisdiction. A wide range of reports can be printed on demand at the remote terminals; some reports and graphics are distributed from Ottawa. Essentially FLASH is a data file, updated daily and as new data is obtained, which can produce combinations and compilations of input data in standard output report form, or in special formats as required. However, it should be stressed that the system is highly reliant on the inputs it receives from DND and DOT.

Finally, there is a DFO database group experimenting with on-line systems for monitoring licensing, catch and effort for the domestic fleet. Known as FEDS - Fisheries Experimental Database System, its purpose is to provide a total domestic fisheries database system and, on an experimental basis, to indicate user needs and demand, database growth and associated costs. It acquires data from DFO regional offices in machine readable form on operations of Canadian salt water fishing industries on both coasts, and on fisherman licences, vessel licences, catch and effort statistics. It has been in operation since 1977, and may be used as a prototype for future fisheries data banks, including a product inspection/industry production data bank. More details on FEDS and other fisheries-related data banks may be found in Appendix 2, p. 2-18.

2.1.4 Special Issues

Since the 200-mile fishing zone was established in 1977, the effectiveness of surveillance is considered to have met the original objective of the program which was to minimize fisheries violations offshore. The relatively low number of violations over the past two years, particularly for the foreign fleet, indicate that the program is functioning reasonably effectively.

The most critical problem arises from the useful life remaining in the Tracker aircraft. At present, they will have to be removed from service by 1985 unless measures can be taken to extend their lifetime. A decision on whether or not such an extension is feasible will be needed within the next 1-2 years, and is being considered by DND.

The principal difficulty in counting on continuing DND support is that the meeting of civilian information requirements is not a primary objective of DND. Future equipment will be required to meet military needs, an example being the Aurora aircraft which, while it has provision for a civilian instrument package, may be too costly to fly dedicated civilian missions, and may not have a suitable flight profile.

Foreign fishing effort has increased in the Atlantic coastal areas outside the 200-mile limit (Flemish Cap and the Tail of the Banks). Stock management in these areas is under international control, but increased Canadian surveillance is required.

During briefings from DFO personnel, the study group was made aware of the need for more research data related to stock assessment and habitat protection. Also, there was indication of a need for increased surveillance in ice-infested waters.

2.2 Non-Renewable Resource Management

2.2.1 General

Non-renewable resource management refers principally to the regulation of offshore oil and gas exploitation, but also includes other mineral resources of the seabed. It embraces exploration, development, production and transportation activities required to bring such resources to market. At present the focus is on oil and gas. Offshore mineral development is minimal and with the exception of coal off Cape Breton, offshore mineral exploration and exploitation is for some time likely to be sporadic and limited to investigations of near-shore sand and gravel deposits.

Offshore oil and gas exploration is accelerating in Canada, especially in remote areas and in deeper waters. The Canadian Petroleum Association estimates the following level of exploration activities on the assumption of favourable conditions (taxation, prices, etc.):

Beaufort Sea	1979-82	average of 4 drillships operating per year
	1982-99	average of 6 drillships operating per year, assuming earlier success
Labrador and Eastern Arctic	1979-85	average of 5 drillships operating per year
	1985-90	average of 8 drillships operating per year, assuming earlier success.
East Coast	1979-85	average of 1 drillship operating per year

Commercial-scale production is expected to start in less than five years. Dome Petroleum estimates crude oil deliveries could begin from the Beaufort Sea by 1985, and even as early as 1983. The Arctic Pilot Project (application now before the NEB) would bring LNG from Melville Island starting in 1983. Gas discoveries off Labrador have not yet been proven of commercial scale, and production is not expected before the mid to late 1980s.

Despite the promise of discovery, there are considerable uncertainties. Much more exploratory drilling is required before the extent of oil and gas deposits are known. The technology of completions has not yet been proven for off-shore installations in ice-infested waters. Water depths, distances from shore, and the presence of icebergs add to the difficulties for leases off Labrador and in the eastern arctic. However, perhaps the greatest source of uncertainty is the economic climate affecting exploration and development. The discovery in Canada of more accessible oil and gas, the cost of imports, the tax structure and thus the market value of the product are all major factors affecting the timing of significant offshore oil and gas activities.

The management of non-renewable offshore resources embodies the granting of permits for exploration and development; supervision and control over offshore activities in the interests of human safety, pollution prevention and conservation of resources; assessing the impact of offshore development on the environment and coastal peoples; undertaking an inventory and economic assessment of the mineral resource potential of offshore lands; and the preservation of Canadian sovereign rights over offshore mineral resources. Environmental considerations related to offshore resources will be treated later under the function "protection of the marine environment".

2.2.2 Data Acquisition and Handling

Non-renewable resource management is the responsibility of the Department of Energy, Mines and Resources on Canada's east and west coasts, and in Hudson Bay and Hudson Strait. North of $61^{o}18'$ (except for Hudson Bay and Hudson Strait) it is the responsibility of the Department of Indian and Northern Affairs. These departments assess all pertinent information when an application for approval of an offshore exploration or development project is made and they regulate and monitor all subsequent field operations after approval is given. Programs subject to such approval include geological, geophysical and drilling operations, and related environmental and technical research programs.

Data is acquired through the applications filed for program approval, from progress reports during the course of the program, and from summary reports submitted after completion of the program. Routine daily reports contain meteorological and oceanographic data some of which is also submitted to AES. Information collected by EMR and DINA is not converted into machine-readable form. It is stored in manual records, at Ottawa, with copies at the regional office in Yellowknife, Dartmouth or Calgary. The type of information stored includes:

- registry of oil and gas permits and leases granted to companies;
- plans and specifications for drilling units and associated equipment such as support craft and diving bells;
- reports of past oil and gas exploration programs, geological and geophysical surveys including marine seismic surveys;
- well histories and location for all offshore exploration and development wells;
- well cuttings and fluid samples and cores for all wells;
- location, disposition, movement, activities of drilling vessels and platforms;
- location of ice platforms;
- location of man-made islands;

- location and description of seabed activities, e.g. glory hole excavation, pipeline construction;
- oil and gas production data when it becomes available;
- environmental reports dealing with the analysis of site-specific meteorological and oceanographic conditions;
- oil spill contingency plans.

EMR and DINA have formal arrangements with DND to provide aerial surveillance by Argus patrol aircraft. They report location, identification, course and speed of all targets which include drilling platforms and drillships, work boats, seismic survey vessels and other research or survey ships. Also, under arctic sovereignty surveillance, DND crews report on location, size, identification and description of seismic lines cut on land, exploration or survey parties on land or ice, lodgements and base camps on land or ice, and drift stations on ice islands. All DND surveillance results are reported to DND Maritime Headquarters, and relevant information is made available to EMR and DINA.

The departments require data at least once per day over active drilling areas, but DND can only provide one flight every two weeks for DINA, and flights at 5-day intervals from May through October for EMR in specific areas, other areas at 1-month intervals.

Regular thorough inspections are conducted on-site at drilling units and survey ships for safety and pollution control purposes, and for strategic reasons related to the deployment and activities of exploration vessels.

All offshore drilling units are required to carry weather and sea state information gathering equipment. Data recorded includes: wave height, period, frequency; wind speed, direction; air and sea temperatures; currents; cloud and ice cover; iceberg density, mass and velocity. The standard meteorological parameters are reported every three hours to AES. Thus each offshore drilling unit at a well site is an offshore weather station feeding data into the AES gathering network. Research and survey ships also carry some instrumentation and regularly feed location, weather, oceanographic and ice data to AES as "ships of opportunity". Some physical oceanographic data from drilling units and ships also are fed to MEDS and OAS institutes.

EMR's Departmental Coordinating Committee on Ocean Mining serves as a focal point for ocean mining interests and maintains a large bibliographic data base which includes a computerized system for storing and retrieving information on offshore mineral deposits, mining and processing technology and related corporate, commodity and legal reference material. More details are to be found in Appendix 2, p. 2-26.

2.2.3 Special Issues

The principal issue appears to be the uncertainty of when major offshore oil and gas activities will occur. The timing of events estimated by the Canadian Petroleum Association covers a broad period and of course is subject to changes in the economic climate and world energy politics. However, it seems most likely that a significant build-up will occur in frontier production by the mid to late 1980s. Such uncertainties make it difficult to plan specific services needed, until firm plans of the industry are known. The lead time needed to put into place services required for adequate levels of safety is a cause of real concern to planners.

As stated above, DND is unable to provide sufficient surveillance flying to meet the minimum needs of DINA or EMR. Current Argus patrol aircraft will be replaced ultimately by the Aurora, but it is not known what the full implications will be for drill site surveillance; certainly with fewer aircraft there will not be any increase in surveillance.

When offshore production ultimately does happen, information requirements will increase dramatically. There will be a need for more detailed and frequent reports on ice, weather, oceanographic parameters, iceberg data, traffic, environmental baseline data, pollution monitoring, etc. In response, AES and OAS will have to expand their network and services, and current departmental data files will have to become more sophisticated.

2.3 Protection of the Marine Environment

2.3.1 General

Protection of the marine environment requires both the prevention of and limitation on the amount of pollutants entering the water, and the minimization of damage from such pollution as does occur. Major activities carried out to effect such protection include monitoring of the environment, specifying standards for shipping and drilling activities to ensure that the amount and threat of pollution from them is minimized, screening and inspecting platforms to ensure their compliance with standards and taking enforcement action where necessary, surveillance of activities that have the potential to produce pollution, the detection and identification of pollution incidents and polluters, the tracking of pollutant substances and the containment, dispersal and clean-up of pollution.

As a general statement, it is the policy of the Government of Canada to protect waters under Canadian jurisdiction from abuses which would:

- pose a risk to human health or safety;
- damage the flora and fauna living within or depending upon such waters; or,
- reduce the value of such waters, from an amenity point of view, for uses such as transportation and recreation.

This policy is implemented by various federal departments and provincial governments through legislation such as:

- the Fisheries Act of Canada;
- the Canada Shipping Act;
- the Canada Waters Act;
- the Navigable Waterways Act;
- the Arctic Waters Pollution Prevention Act;
- the Ocean Dumping Control Act;
- the Environmental Contaminants Act;
- the Oil and Gas Production and Conservation Act.

All Canadian waters require protection against the threat and effects of marine pollution. Offshore hydrocarbon development and the increasing transport of pollutants by water are producing an increase in the risk of a significant spill and thus environmental damage. The behaviour of oil in water or under ice is not fully understood, so that only tentative predictions can be made regarding the impact of a major incident on the marine environment. However, inshore areas with high concentrations of renewable resources and the arctic are particularly sensitive and vulnerable. In response to its high priority on offshore energy development, the government has established a number of programs designed to gain a better understanding of the marine environment, and to examine the best means of detecting, containing and disposing of contaminants.

The Beaufort Sea Project, completed in 1976, carried out environmental baseline studies, established environmental criteria (weather, ice and sea state) for drilling in the southern Beaufort Sea, and evaluated oil spill countermeasures including detection, containment and cleanup. Subsequently, the Eastern Arctic Marine Environmental Studies (EAMES) were established in response to drilling plans for the Davis Strait, Baffin Basin and Lancaster Sound. EAMES involves studies of physical oceanography, meteorological and related factors, marine biology and related wildlife, and the further assessment of oilspill countermeasures. In the subarctic region of the Labrador Sea, marine biology is being researched through the Offshore Labrador Biological Studies (OLABS), an industry-community-government program designed to assist in the environmental assessment of oil and gas development. Industry has ongoing oceanographic, meteorological and marine engineering studies in the region. Finally, the Arctic Marine Oilspill Program (AMOP) was established late in 1976 as a crash program to develop the necessary countermeasures equipment and procedures to deal with arctic oil spills.

With respect to all pollution from ships, both accidental and operational, the Canadian Coast Guard has full responsibility under Part XX of the Canada Shipping Act, and regulations under the Arctic Waters Pollution Prevention Act. These acts provide a wide range of statutory powers for the prevention and control of ship-source pollution, including the ability to set discharge, construction and equipment standards, board and inspect ships and, if necessary, refuse them entry to Canadian waters or detain them in-port. Financial protection is afforded through the specification of maximum amounts for fines, the requirement for shipowners to provide proof of financial responsibility, provisions requiring the polluter to assume the major burden of clean-up costs, and the establishment of the Maritime Pollution Claims Fund, based on levies against imported oil as an unsatisfied judgement fund to reimburse both private and public sectors for losses incurred as a result of a pollution incident.

In support of this legislation, the Canadian government employs programs of aerial surveillance (multi-tasked DND aircraft plus some dedicated Coast Guard time), in-port inspection, and vessel traffic management (to identify sub-standard ships in timely fashion so that environmental risk is minimized). These programs generate substantial information demands which require considerable data collection and processing facilities to support them.

Due to the conditions under which marine environmental legislation has been formulated, Canada now has a pollution control regime intended only for coastal and inshore waters applying over the full extent of the 200 mile zone. This creates considerable enforcement difficulties and overextends current resources. As a result of this fact, together with recent improvements in pollution control technology, and a newly-emerging international regime which offers prospects of an effective global approach to problems of vessel source pollution, Canada is currently conducting a review of standards and programs to determine what legislative and operational changes are required.

2.3.2 Data Needs

In order that rational decisions can be made concerning the environmental impact of proposed offshore developments such as exploratory drilling, site-specific or regional environmental baseline data is required. The need for such regional information motivated the Beaufort Sea, EAMES and OLABS projects. For the Environmental Assessment and Review Process,* concern has been expressed over government capabilities to integrate environmental data on a regional basis. Also, much environmental baseline data is not available in regions of importance to future energy and transportation projects.

* For more details, see Appendix 2, p 2-39.

Aside from the data itself, a significant amount of research is still needed on the behaviour and movements of pollutants in cold water and their effects on renewable resources, especially fish stocks.

With respect to operational pollution from ships, real time information is required on the type, location and source of discharge. In order to obtain evidence suitable for presentation in court, a positive unambiguous connection has to be established between the discharged pollutant and the vessel that generated it. This requires that the vessel be observed in the act of polluting, a difficult task in view of the large expanse of ocean area to be surveyed and limitations on detection capability at night or in poor weather. Information obtained on operational discharge has to be transmitted immediately to ensure an effective response.

To provide the necessary safeguards against accidents which might result in pollution, vessel traffic management systems must be able to satisfy a wide variety of data needs including the positions and conditions of ships in the system, their past histories and their cargoes.

In responding to a pollution incident, real time information is required on type, location, source and drift of the pollution, as well as the prevailing environmental conditions. This information has to be continuously updated in order to ensure the most effective and efficient response.

The Environmental Protection Service (EPS) of DOE maintains a number of archival information systems related to marine pollution and environmental emergencies which are referred to below. The Environmental Assessment and Review Process operated by DOE assembles marine environmental data from a wide variety of sources in order to assess the impact of non-renewable resource activities. The lack of site-specific and regional environmental data continues to be an impediment to rational decision-making on offshore environmental issues.

2.3.3 Data Acquisition and Handling

a) Data Acquisition

For the Environmental Assessment and Review Process, data is acquired through specific research programs, baseline studies and projects conducted by the government or contracted with the private sector. While the Beaufort Sea, OLABS and EAMES projects have provided valuable environmental data, other site-specific and regional projects can be expected as non-renewable resource projects and shipping activities are undertaken in new regions off Canada's coastline.

Data acquisition for the control of operational pollution relies mainly on DND coastal patrol aircraft, supported by follow-up action ashore. The in-port inspection program and the various vessel traffic management systems provide the data acquisition capabilities with respect to the prevention of incidents. Vessel traffic management parameters which govern the area-coverage type systems are described more fully in section 2.4.2 and Appendix 2, p. 2-49. Once accidental pollution has occurred, data acquisition is governed primarily by its location, with DND coastal patrol aircraft plus government ships providing the major capability offshore.

In the future, it is likely that multi-tasked surveillance from DND aircraft patrols will continue using the Trackers and replacing the Argus with the Aurora. Also the Dash 7R has been suggested as a surveillance aircraft that could be applied to pollution control. Aircraft remote sensing technology is showing promise. The EMR/CCRS experimental oil-spill monitoring package is being tested in connection with the AMOP program. It includes a synthetic aperture radar, laser fluorosensor, low light level television camera and an infrared line scanner.

Surveillance satellite systems also could be useful in the longer term for pollution surveillance because of their wide area, strategic coverage, and possible all-weather capability through use of synthetic aperture radar techniques.

b) Data Handling

For control of operational pollution, DND surveillance reports are sent directly to the Coast Guard and EPS. In the event of vessel traffic management becoming aware of a potential pollution-causing incident, decisions are made either by traffic regulators, or the appropriate expertise is consulted. In the event of a marine emergency requiring Coast Guard response, information is transmitted via the Coast Guard Traffic Centre to the Area On Scene Commander. The type of information involved includes:

- analyses of the disaster,
- vessel owner's intentions in relation to the incident,
- alerting and making available people and equipment which can render assistance,
- details concerning the environment (i.e. weather, sea state, etc.),
- information on the conduct of the operation itself,

EPS operates a number of archival information systems in connection with its water pollution control, ocean dumping, environmental contaminants and environmental emergencies programs. They include:

- NEELS - National Emergencies Locator System
- NATES - National Analysis of Trends in Emergencies System
- Ocean Dumping Permit Files
- Watenis - Water Effluent Information Systems
- Hazmats - Hazardous Materials Information System

Details of these systems may be found in Appendix 2, p. 2-38.

2.3.4 Special Issues

Two special issues related to protection of the marine environment are the need for more baseline environmental data, and the application of remote sensing for the detection, mapping and tracking of oilspills and other pollutants. Baseline data is needed anywhere environmental impact statements are required including all major offshore drilling sites and tanker routes. The study group was told that available data is far from adequate, and that resources and planning need to be devoted to the gathering of such data if environmental assessment and review processes are to be meaningful in future.

Remote sensing shows promise of being an effective means of mapping and possibly detecting spills. Recent funding cutbacks may retard decisions regarding the operational feasibility of the technique. It may be that the CCRS experimental system may have to prove itself under actual emergency conditions before its full potential is recognized.

2.4 Development and Control of Navigation

2.4.1 General

The development and control of navigation in respect to the oceans generally falls under the mission of the Canadian Coast Guard within the Department of Transport. The Coast Guard mission can be described under three headings:

a) The Way - to ensure that shipping has access to ports in Canada

- maintain access for shipping to and from ports in Canada.
  (Navigation Aids, Icebreaking, Dredging, Hydrography, Enforcement of Navigable Waters Protection Act).

- access is ensured by maintaining channel depths, deploying aids to navigation to mark routes and hazards, providing icebreaker assistance and enforcing the Navigable Waters Protection Act to keep waterways clear of obstructions to navigation.

b) The Vehicle - to ensure that ships are in a seaworthy condition before making a passage.

i) Ship Inspection - board, inspect, issue certificates and clear shipping for navigation in waters under Canadian jurisdiction, (Canadian Shipping Act Parts II, VIII and XX, Arctic Waters Pollution Prevention Act).
Technical standards for seaworthiness concerning the state of the hull, machinery, equipment, crew and cargo are established, maintained and enforced.

ii) Certification Inspection - locate, identify and screen shipping in waters or ports under Canadian jurisdiction (ECAREG, NORDREG, radio safety watch, radar, air and surface surveillance). Ships are located, identified and tracked when in Canadian waters or ports under Canadian jurisdiction, and verification is made of compliance with Canadian standards of seaworthiness.

c) The Voyage - to ensure that voyages are prosecuted as safely and expeditiously as possible.

i) Movement Control - establish, enforce and execute measures for navigation control in waters under Canadian jurisdiction. (Rules of the road, routine, traffic separation schemes, local VTM, pilotage).

Voyages in waters under Canadian jurisdiction are subject to a degree of navigation control to ensure that traffic is adequately separated and routed, collision and grounding situations are avoided and the flow of traffic expedited.

ii) Emergency Control - respond to and control emergencies in waters under Canadian jurisdiction (SAR, marine emergency organization - salvage and aid)
Marine emergency forces are maintained at strategic locations for rescue, salvage and pollution clean-up.

The principal management activities supporting the mission areas related to the development and control of navigation are:

a) Development and deployment of en route navigational way systems and support services, and enforcement of the Navigable Waters Protection Act,

b) Development and enforcement of Canadian regulations for the construction, manning and operation of ships,

c) Vessel Traffic Management at a range of levels from local harbour control to movement control in major rivers and connecting channels, and ocean control systems such as the Eastern and Arctic Canada Traffic System ECAREG/NORDREG,

d) Development and maintenance of a marine emergency response organization and capability.

The level of management activity associated with development and control of navigation is proportional to changes in the

the volume and composition of shipping traffic, changes in the international and domestic regulatory regimes and factors such as trends in international trade, the international energy situation, and industrial stimulation policies. While there is a general tendency for traffic to increase with time, especially in the confluence zones, such as the St. Lawrence Seaway and the west coast, changes in shipping technology, such as containerization, roro shipping and VLCCs are producing a general tendency for more cargo to be carried in less ships.

There are special concerns associated with Very Large Crude Carriers (VLCCs) now on the west coast tanker routes between Alaska and the State of Washington, and with liquid natural gas (LNG) tankers operating out of the eastern arctic to the Bay of Fundy and St. Lawrence River areas, which could begin as early as 1983. Also, there is the possibility of offshore oil and gas production and associated tanker traffic from the arctic in the mid to late 1980s, especially in the Beaufort Sea. Any northern pipeline would involve significant vessel traffic. All such arctic marine activity will generate increasing requirements for icebreaker assistance, ice and weather information, vessel traffic management, navigation aids and communications. The general tendency is towards increasingly closer monitoring and control of marine traffic by DOT (e.g., mandatory ECAREG participation, more VTM centres, mandatory VTM participation, eventual extension of NORDREG, etc.).

2.4.2 Data Needs, Data Acquisition, Data Handling

Data needs for the development and control of navigation are discussed below under each specific management activity:

a) <u>En-Route Navigational Way Systems</u>

i) <u>Aids to Navigation</u>

The marine aids system in Canada consists of approximately 16,000 navigational aids of different types, including buoys, shore lights, markers and beacons, radio and radar beacons, Decca, Loran A on the east coast, Loran C on the west coast, and Omega. The Aids to Navigation organization provides ongoing operational information to mariners on the status of the Coast Guard's navigational aids and on the aids systems required by users.

System information requirements are concerned with whether or not the components of the aids system are operating within acceptable standards. The information is obtained through automatic readout at VTM centres and Coast Guard radio stations on the status of many electronic and shore light navaids. Other information is gathered through aids checking operations by the Coast Guard and from mariners' reports to the Coast Guard on system anomalies. Dissemination is by Coast Guard radio, VTM centres, ECAREG and NORDREG centres.

In future, Loran C may be installed on the east coast, and the satellite Global Positioning System (GPS) should be operational by the mid-1980s. More extensive navaids may be necessary in the arctic as shipping there expands which will give rise to an increase in the volume of information needed to support the system.

ii) Ice Operations

Coast Guard Ice Operations Services include the provision and operation of Coast Guard icebreakers, facilities and services to ensure the safe and expeditious movement of shipping in ice-infested waters. This includes provision of advice on routes, formation of convoys and escort of shipping through ice, both in southern Canada and in the arctic, support of the northern settlement resupply, and the provision, operation and maintenance of specialist ice operations services in support of non-Coast Guard departments and agencies. Operational tasks undertaken to accomplish these objectives include the use of icebreakers for ship escort duties, freeing ships beset in ice, maintaining a track in port ice, clearing ice jams, clearing harbours and wharfs, providing ice information, checking and maintaining winter navigation aids systems, and emergency services in ice-infested waters.

Ice operations require effective ship-shore communications. Messages are of 4 types: those pertaining to weather and ice conditions, those concerning the status of aids to navigation, those concerning traffic disposition and VTM reports from ships. Each area is under the surveillance of a Coast Guard Regional Traffic Centre which a ship's master may call for advice and assistance. Requests for assistance are processed through to the Ice Operations Office. From this office, area control of icebreaking is maintained. Ship movements are monitored, and information on ice and weather conditions is processed, enabling icebreakers to facilitate passage through ice-covered waters by selecting tracks that minimize delays and the possibility of damage.

There are four different categories of information needed for ice operations:

- Research information - to study its engineering properties and dynamic characteristics for ship, icebreaker and shore installation design; and remote sensing techniques for ice reconnaissance.
- Planning information - for pre-season planning of ship utilization and fleet composition.
- Strategic information - in real time for the planning of voyages and ice reconnaissance.
- Tactical information - in real time within the immediate area of the ship on a nearly-continuous basis.

iii) <u>Communications</u>

The Coast Guard has the responsibility for all ship-to-shore safety communications, and establishes the standards for shipborne radio installations. Ship-to-shore public and government correspondence communications requirements also are provided. The services are provided through 56 Coast Guard Radio Stations.

Safety communications includes the services needed for maintaining continuous guard on maritime mobile international distress, urgency and safety frequencies, the main communications for SAR incidents, the services needed for VTM and the aids to navigation systems. Correspondence communications includes coastal and high sea message services, maritime telephone service, and service to some isolated communities in the arctic. Government communications needs are fulfilled by a third type of service between the Coast Guard and other government departments including the transmission of oceanographic and meteorological data for national and international requirements. Growth in all three services can be expected as the volume of shipping expands.

iv) Other En-Route Services

Other en-route way systems and services which form elements of the Coast Guard function are sounding and dredging in the St. Lawrence River and other areas to maintain channel depths at prescribed levels, and of particular importance, the Coast Guard responsibility for enforcement of the Navigable Waters Protection Act to ensure that all navigable waters in Canada are clear from obstructions or structures which may impede the free movement of vessels.

b) Regulations for Construction, Manning and Operation of Ships

This management activity is essentially directed towards ensuring that adequate Canadian regulations are maintained and enforced for standards of ship seaworthiness, including construction and maintenance of the hull, machinery and equipment, manning standards and licensing of crews, cargo stowage and stability regulation, and load line and lifesaving appliances rules. The Coast Guard ensures that the standards prescribed by International Conventions to which Canada is a signatory, such as SOLAS, IMCO, etc., are enforced in Canadian waters. In this respect, while much of the Coast Guard regulations conform to accepted international standards, Canada has, in the last few years, taken a number of unilateral initiatives, particularly with respect to its pollution control legislation developed under Part XX of the Canada Shipping Act and the Arctic Waters Pollution Prevention Act. The ship construction standards for navigation in ice developed under the latter are now gaining world-wide currency.

With respect to system information requirements of this activity, as it relates to the ocean management function, the at-sea element is executed through the Vessel Traffic Management System where ships are located, identified and tracked either before entering Canadian waters or during passage in Canadian waters, and by the verification required of the ship's various certificates of seaworthiness.

In part, inspection also is carried out by Coast Guard surveyors who board and inspect ships and issue certificates for navigation in waters under Canadian jurisdiction.

c) Vessel Traffic Management

Vessel Traffic Management provides for varying degrees of marine traffic management from assistance to control throughout east coast waters (including the eastern arctic), the St. Lawrence River and Seaway, the Great Lakes and on the west coast. The main objectives of VTM are the prevention of collisions between ships or between ships and other obstructions, the maintenance of safe, expeditious and orderly flow of shipping on those waters under jurisdiction, and to alert appropriate authorities when ships are in need of help. Various levels of control have been established, but at present only in Halifax harbour, the Bay of Fundy, the St. Lawrence River and Canso Strait is participation in the system mandatory. Details of VTM can be found in Appendix 2, pp. 2-49 to 2-54.

The main information provided by VTM systems to vessels includes notification of all traffic in the vicinity, hazards to navigation, Notices to Mariners, expected movements of vessels that may cause special hazards, current and forecasted weather, sea state and ice conditions. In order to provide such information, VTM requires permanent and current vessel data which involves access to the ECAREG file (see below) and real-time data received directly from each vessel entering a VTM zone. Also required is data on permanent hazards and the movement of vessels operating within the zone; details related to marine operations in the zone such as pilots, port authorities, inspectors, etc.; meteorological and oceanographic data.

While the data presently being collected is sufficient to meet current VTM needs, in future the same type of data will be required over larger tracts of ocean as higher levels of VTM are introduced in zones dictated by growth in traffic density.

The Eastern Canada Traffic System (ECAREG) was introduced in July, 1976, to provide real-time information and advisory traffic service to mariners, to screen shipping when it enters Canadian waters and to ensure compliance with regulations on vessel standards. It covers the area within the 12-mile the territorial sea on the east coast south of 60^{o}N, but excludes waters under VTM centre jurisdiction. NORDREG serves the same purposes for waters covered under the Arctic Waters Pollution Prevention Act.

ECAREG centres have been established at Dartmouth, St. John's and Montreal to act as coordination centres for the application and implementation of contingency plans and regulations in matters related to pollution, defects and deficiencies in vessels, marine casualties, navigational hazards (providing notices to shipping), ice operations and coordination of fleet operations. ECAREG applies to all vessels over 500 tons, those carrying pollutants or dangerous goods, or any vessel towing such vessels.

Vessels wishing to enter Canadian territorial waters must report to ECAREG Canada 24 hours in advance. The request for clearance for the vessel's intended route through the ECAREG zone must be accompanied by vessel characteristics, course and destination, cargo description, data on pollutant or dangerous cargoes, deficiencies in navigation, propulsion or manoeuvering equipment, conditions which are causing or may cause pollution, icebreaker and pilotage requirements, reports on accidents, pollution, hazards to navigation and improper functioning of navigation aids. Detailed vessel information is on permanent storage if the vessel has visited Canadian waters previously.

Since late 1978, compliance has been mandatory, and in future, it it likely to be extended to 200 miles off shore. Under such conditions, surveillance capabilities would have to be increased significantly. Also ice and weather services, and communications would need to be extended.

NORDREG has similar characteristics to ECAREG, but now only operates during the arctic shipping season from a centre in Frobisher. If LNG tankers and VLCCs begin to operate in the arctic year round, it may be necessary to operate NORDREG all year as well, although system effectiveness would be limited without development of more reliable arctic communications.

d) Marine Emergency Response Capability

This management activity is concerned with maintaining a rapid response organization and capability for the purpose of controlling emergency situations in Canadian waters. Its primary elements are the Coast Guard Marine Emergency Branch and the Coast Guard Search and Rescue Division, and their associated operational organizations. The C.G. Marine Emergency Branch has developed both national and international marine contingency plans and is responsible for the maintenance of a national strategic response capability for pollution clean-up in the form of stock piles of equipment at key locations throughout the country. It participates in exercises at the national and local levels in conjunction with other departments to develop its contingency response capability. The Coast Guard Search and Rescue organization provides the marine element in the national search and rescue organization which includes the provision of Coast Guard search and rescue officers in the DND Rescue Coordination Centres, and the provision and operation of a fleet of specialist search and rescue ships.

The system information requirements associated with the Marine Emergency activity are concerned with the expected movement of vessels, rapid notification of distress or breakdown, pollution or other emergency circumstances, information on the availability and whereabouts of vessels, both government and commercial, which can provide assistance (the SAR organization has access to the USCG AMVER system in this respect), and the need for almost continuous information on the situation as the emergency response operation develops. Primary elements of the communication system are the Coast Guard radio station networks and the Coast Guard Vessel Traffic Management systems.

2.4.3 Special Issues

The general growth of marine operations suggests expanded control over high-traffic regions of Canada's oceans by the Coast Guard in the interests of safety and sovereignty. Growth, as such, has not appeared as an issue during the study, but two issues were revealed during briefings and the field visit to Dartmouth. The first relates to hydrographic charts provided by the Canadian Hydrographic Service under the ocean service function described in a later section. Evidently certain regions near Newfoundland have not been charted since before the turn of the century when it was done by the British Admiralty. There have been sufficient changes since to create a safety hazard in the view of the Coast Guard's Fleet Systems office in Dartmouth. Either improvements are needed in the mechanisms for transferring Coast Guard's concerns to the Canadian Hydrographic Service, or insufficient resources are available.

The second issue relates to the need for reliable communications and navigation systems in the arctic as traffic expands. However, the nature of needs in the arctic is special because of the long distance involved, and because of the HF blackouts that occur in the auroral zone.

A future generation of the international maritime satellite system INMARSAT may be capable of providing coverage of the Canadian arctic, for maritime mobile services, up to about 75°N. latitude. This, however, is unlikely to happen before the 1990s. Such coverage may be provided at an earlier date by the proposed Canadian multi-purpose UHF satellite, MUSAT. It could provide voice, data, and facsimile capabilities to land-based mobile or transportable stations, as well as to maritime users, perhaps by the mid 1980s if problems of interdepartmental funding can be resolved. Largest potential users are DND, DOE, DOT, EA, DINA and the provincial governments. MUSAT will provide communications to locations where the satellite evaluation angle is greater than 5^{o} above the horizon (i.e. up to about 75^{o} - 76^{o} North latitude, including Resolute Bay where the elevation angle is 6.2^{o}) provided there are no major obstructions in the satellite line-of-sight. Communications up to about 80^{o}N is expected to be feasible with a higher power allocation from the satellite and earth station. Beyond 80^{o}N no coverage could be provided by MUSAT or INMARSAT.

The need for adequate navigation facilities in the arctic will become acute when large tankers begin transporting oil south in commercial quantities. Canmar has stated it will operate VLCCs through the arctic all year round by 1985. The Arctic Marine Locomotive (AML) may be operating as early as 1983.

GPS is a USAF navigation satellite operational by the mid-1980s, providing global coverage (including the high arctic) and available to any civilian user with a suitable receiver. Costs of the receiver could be prohibitive for many vessels, but unless the Loran C network is extended, GPS will be the only form of electronic navigation in some regions of the arctic.

2.5 Defence

2.5.1 General

By agreement, the study has not been concerned with information requirements for military purposes, but rather with DND's role in support of civilian management activities. Provision of data in support of civil agencies, in DND terms, is a function secondary to the use of military equipment to satisfy military needs, and only when such equipment happens to serve a secondary purpose during the course of a military mission will the relevant data be required for civilian ocean management purposes. Such is the case with DND's patrol aircraft and vessels, many of which provide data for use by civilian agencies. The following paragraphs describe only those aspects of DND operations of interest to the study group.

2.5.2 Data Acquisition and Handling

DND operates three patrol aircraft: the Argus, the Tracker and the Sea King Helicopter. Details concerning the capabilities of these aircraft may be found in Appendix 2, p. 2-67.

Some Tracker aircraft had been retired from military service, but were reactivated to support requirements of civilian departments. A decision is required within the next 1-2 years on whether their lifetime can be extended beyond 1985.

The Aurora (LRPA) aircraft becomes operational in 1981. There is provision for a civilian remote sensing pod, but so far no civilian agency has seen fit to commit the resources needed for such a package.

DND operates a fleet of combat vessels, operational support ships, submarines and various training, research and auxiliary vessels capable of position fixing, radar surveillance of aircraft, photo, radio frequency monitoring, meteorological and oceanographic observations, pollution observation and verification, sonar and visual acquisition.

Data handling will be performed by the new MCOIN II automatic data processing system to become operational at MARCOM Headquarters by 1982. While there are no plans to do so at present, MCOIN II could be linked directly to civilian systems with appropriate blocks for security information.

Also, there are centres in Comox, B.C. and Greenwood, N.S. to be operational in 1981 for computer-based reduction and analysis of data from the Aurora.

Table 2-1 shows civilian surveillance tasks presently being performed by DND.

At Halifax and Esquimalt, DND operates Meteorological and Oceanographic Centres, METOCs, to aid DND responsibilities and activities, to determine meteorological factors affecting ocean activities in the area, and to supply wave forecasts. Data is acquired in real time to WMO standards from AES and world meteorological networks, the US Fleet Numerical Weather Centre, the USAF, offshore DND patrols including subsurface data, AES sensors (ships and launches) and OAS wave stations. Operated by AES personnel on secondment, METOC provides and receives meteorological and oceanographic information packages and wave forecasts to and from DND users, the AES network and other users including MEDS. For more details, see Appendix 2, p. 2-77.

Search and Rescue (SAR) operations are handled through Rescue Coordination Centres (RCCs) co-located with DND facilities in Halifax, Trenton, Esquimalt and Edmonton. While DOT is the lead agency for marine SAR, as described in Section 2.7.1, any information from any source

incidents requiring SAR response is communicated to RCCs through the DOT marine communications network and/or other facilities. Aircraft and some vessels are required to carry emergency transmitters (ELTs for aircraft, EPIRBs for vessels) which transmit signals on distress frequencies for locating craft in distress. In terms of needs, improved capabilities are required for the real-time detection, location and identification of vessels in distress in order to reduce the time between onset of distress incident and rescue. Also there is a need for real-time information on location and identification of shipping and aircraft which might assist in a SAR incident. For more details, see Appendix 2, p. 2-90.
In response to such needs, R and D is now underway on improving the reliability of ELTs and EPIRBs. Developments in VTM, and improvements in weather, ice and sea state forecasting can be expected to improve SAR operations. Also, Canada will participate with the U.S. in the experimental SARSAT program - a satellite that will, through the detection of EPIRB/ELT Signals, give the position of vessels or aircraft that are in distress.

2.5.3 Special Issues

The table of surveillance tasks reveals the large extent to which civilian agencies have come to depend on the military to perform surveillance missions. Since support to civil agencies is a secondary objective of DND, it is possible that future operational and equipment purchasing decisions within the Department could compromise certain of the civilian support, because such decisions must be based, of necessity, on the Department's primary missions. However, it should be emphasized that good communications and linkages do exist between DND and the civilian departments being supported.

The study group identified specific concerns with respect to surveillance platforms. The first is the Tracker which currently is scheduled to be phased out of service in 1985. Aircraft additional to DND requirements were brought out of mothball to support civilian purposes. Thus civilian agencies now using the Tracker as a data acquisition platform either will have to come to terms with DND when that department considers a replacement of this surveillance capability, or look elsewhere to satisfy their surveillance needs.

The second issue involves the provision of a civilian pod on the Aurora. The costs both of instrumenting the pod and operating the aircraft have caused potential users to lose interest. Earlier studies* revealed a large number of potential users and applications for the pod, mainly from the research sector where many expressed interest in having their equipment fly as a passenger on military missions. When these aircraft owned by the government are conducting patrols in any event, it is unfortunate that costs were considered prohibitive for other users to take advantage of the platform, particularly when provisions could be made for a civilian sensor pod. This matter might be re-examined in the light of present day circumstances.

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* Anon., "Proposed Use of the LRPA for Airborne Tasks In Support of Civilian Departments", Final Report of Task Force on Civilian Airborne Sensing from the LRPA, Report No. LRPA-01B-OPR-001/74, May 1974 (for official use only) - Ref. 3

TABLE 2-1

CIVILIAN SURVEILLANCE TASKS PERFORMED BY DND

Surveillance Task	Reported By and To	Information Flow
1. Fisheries Patrol	Post-flight or daily report to Canadian Agencies; violation reported by immediate air message.	Ship and air reports to DFO, entered into FLASH system.
2. Pollution Surveillance	Immediate air report within 100 NM. of coast, post-flight report 100 NM. to 200 NM.	Pollution report and photos of pollutant/ violator forwarded to Canadian Coast Guard.
3. Ice Reconnaissance	AES observers accompany aircraft patrols	Observer plots recovered areas, forwards information to Ice Central, Halifax and Toronto as well as US Coast Guard.
4. Oceanographic and Weather Data Collection	Ship observation and post-flight reports sent to METOC centres.	Weather reports to AES; oceanographic data retained for short-term use.
5. Northern Survey of Unusual Activity, Oil Exploration and New Airfield Survey	Post-flight reports to Northern Region Headquarters Observers normally accompany flights	Collected data coordinated by NRHQ. Pertinent information extracted for individual use by various departments.
6. Wildlife Survey, Hooded Seal Survey, Whale Reporting	Post-flight reports, accompanied by observers.	Unique data collected by observers apply to their own research programs, i.e. polar bear abundance and migration.

2.6 Services: Meteorological and Ice Information

2.6.1 General

The Atmospheric Environment Service (AES) within DOE is responsible for the provision of meteorological and ice information services to Canadian and foreign users as a full participant in the World Weather Watch (WWW) program, and as such for operating the Canadian components of the Global Observing System, the Global Data Processing System, and the Global Telecommunications System of the WWW. The total system operated by the AES can be regarded as a massive "information pump" integrating data from many sources, processing this data and, through the use of prediction models, and other techniques, generating weather and ice forecasting products that are distributed to weather service offices and user agencies throughout the country and beyond as required.

All of the ocean management functions need weather and ice services to varying extents - fisheries for the safety of fishing vessels, oil rigs for the safety and security of exploratory drilling operations, all forms of marine transportation for safety and economical routing, regulatory agencies for establishing regional load-line limits and vessel specifications, etc. Activities in the arctic are particularly dependent on AES services because of the very real environmental hazards faced by ship and oil rig crews.

Specific operations activities of the AES include the acquisition, collection and archiving of basic meteorological and ice data; the analysis, description and prediction of atmospheric conditions and of ice conditions in navigable waters; the dissemination of current and predicted meteorological and ice information to the general public and to special users; the provision of historical meteorological and ice data and information; consultation on applications of routinely available and archived information to user activities. In future AES will increase its emphasis on the provision of more integrated environmental forecasts for particular applications such as special regional marine and ice forecasts, flood warnings, storm surge and severe weather forecasts, etc. Also there is an increasing number of private-sector meteorological operations emerging in Canada which could alter the structure of new services to appear in future.

2.6.2 Data Needs

In general, AES requires data on weather, ice and sea state parameters, and utilizes other special information about the natural environment to fulfil national and international obligations. It operates separate weather and ice forecasting services, two METOC Meteorological and Oceanographic Centres with DND, and performs a number of specialized services through its Special Function Centres. However, it is becoming increasingly necessary to integrate data from the separate AES sources. For example, ice, weather and sea state data are all needed to provide the necessary forecast products for the safety of drillships. Thus while AES operates a number of separate services, its needs for data are considered to serve AES as a single, integrated system.

AES operates a large network of data acquisition weather stations throughout Canada, with grid spacings ranging from 100 km. in the south to over 500 km. in the more remote northern regions. Stations in the network vary in the type of data they put onto the circuits, and there are several types of stations which are described below and in Appendix 2, p.2-74. Data needs are prescribed by the numerical prediction models used by AES, and by the requirements of the inventory of forecasting programs. In addition, certain climatological data are required by the Canadian Climate Centre and Regional Offices.

Essentially, for its core meteorological services, the data needs of AES derive from existing gaps in the network in and near the regions of concern. For existing services to improve in the arctic, more weather stations will be needed there. Hudson Bay creates a large gap in the network spanning the main land mass, and improvements could be made by adding some strategically-located data points there.

Of immediate concern to AES is the decision by the government to phase out the ships at Ocean Station Papa in the north-east Pacific Ocean some 900 km. west of Vancouver. Two ships alternate in serving the station; however, the first is to be out of service by July, 1980, the second, one year later. AES and the Global Data Processing System need data from this area, and plans are currently in hand to overcome the loss of the ships by alternative means as described below.

Ice information is needed in all regions off Canada's coast line where ships will encounter ice. In the winter, the regions of concern are the St. Lawrence Seaway, Gulf of St. Lawrence and eastern seaborad including Newfoundland waters, the Grand Banks and eastern approaches. In summer, at present, the important regions shift north to the Labrador Sea, Hudson Bay and Strait, and the major shipping routes in the arctic. Of particular concern are the off-shore drilling sites in the Beaufort Sea and off Labrador. Within a few years it is expected that year round reconnaissance in the high arctic will be required as the resource extraction programs gather momentum.

The type of ice information required includes the extent of coverage; type, age and estimated thickness; movement; distribution and height of ridges; snow cover; location, extent and size of leads and polynias; location and drift of icebergs. Ice thickness and pressure also are needed but beyond the visual estimate of experienced observers, there are no proven techniques for measuring such parameters from an aircraft.

Ice reconnaissance is conducted by two Electra aircraft operated under lease from Nordair. One is fitted with Side Looking Airborne Radar which permits all-weather operation and interpretation of ice conditions. The aircraft are approaching the end of their useful life and a decision is needed soon as to their replacement. Increased arctic coverage will be required as shipping and drilling activities expand there. Thus, it is likely that more aircraft than at present will be required in future to cope with the need for such coverage.

Because of the dynamic properties of ice, and the threat it poses to ships, drillrigs and other engineering structures, there is a need for real time "tactical" ice information for use by masters in the immediate course of their journey or operations. In order to direct aircraft to the appropriate points to provide such tactical information, there appears to be a need for more strategic information, at smaller scale, which might be provided by a radar satellite.

2.6.3 Data Acquisition and Handling

a) Data Acquisition

In the principal meteorological network there are 36 land stations and Ocean Station Papa for upper air data, 245 land stations and 200-365 ships of opportunity for surface data, 32 automatic stations, 10 radar stations and 4 satellite receiving stations. In addition, there are 2312 climatological stations. AES also receives reports in or near real time of operational significance from aircraft, drill rigs and drillships, agriculture, forestry and provincial agencies. Ships in Canadian waters report weather, pressure, sea state, ice, air and water temperature data. Details are available in Appendix 2, p. 2-74

In future there will be increased emphasis on satellites, automatic stations and data buoys. Satellite imagery is being received from polar orbiting US weather satellites, and the Satellite Data Laboratory in Toronto is receiving data directly from the Geostationary Operational Environment Satellite, GOES East. GOES not only produces imagery, but also retransmits data received by it from remotely-located Data Collection Platforms (DCPs). It is planned for Vancouver to receive communication from DCPs via GOES West. There is some hope that the Tiros-N Operational Vertical Sounder (TOVS) system being experimented with on Tiros-N might ultimately replace the need for upper air measurements. TOVS data is being received at Edmonton and Toronto, but will not be used operationally until the data processing systems have been developed. Funding for these developments has been included in Treasury Board submissions on Ocean Station Papa replacement and the AES satellite program. Automatic weather stations may replace many manned stations in future. For example, in addition to the 32 automatic stations now in place across Canada, 4 currently manned stations in the arctic are planned to be automated.

Data buoys, especially drifters, are emerging as a cost effective means of acquiring meteorological data. The success of the First Global GARP Experiment (FGGE) buoy program has led to recent plans to use medium capability drifting buoys as a partial replacement for the Ocean Station Papa ships in the NE Pacific. The interim plan is to deploy a series of drogued drifting buoys in the vicinity of Papa which would drift toward the BC coastline over the period of a year. Approximately six drifters on a 100-200 km. grid would be operating at any one time, providing surface air pressure and sea surface temperature values 2-4 times daily in the region between Papa and the coast. (In addition to data buoys, the Papa replacement program includes three automatic weather stations on the west coast, and the installation of a GOES West receiving station in Vancouver including an interactive data retrieval system).

For ice forecasting, data acquisition is from inland stations, ship reports, aircraft reconnaissance and satellite pictures. As stated earlier, the present Electra aircraft are coming to the end of their useful life. The Dash 7R is a likely successor but it has not been determined as yet whether the aircraft will be operated by the government (DOT) or leased by the private sector, which is preferred by AES. At present real aperture side-looking radar provides all-weather performance for the ice patrol aircraft. The CCRS SAR-580 experimental aircraft is showing considerable promise for the synthetic aperture technique in the future.

Satellites also may have a role in ice reconnaissance. Early data from the synthetic aperture radar on Seasat (now not operating) looks encouraging. Satellite imagery could be used strategically to direct aircraft to locations where tactical information is needed most.

b) Data Handling

Data acquired by the AES network and other sources is transmitted via the meteorological communication system to a number of centres - the Canadian Meteorological Centre (CMC) in Montreal, the World Meteorological Centre in Washington, Weather Centre and Forecast Offices across Canada, Special Function Centres and Weather Service Offices. CMC is a central computer facility that performs simulations and provides computer products to a wide range of users including the Weather Centres and Forecast Offices which provide regional and local forecasts of all types - public, marine, aviation, etc. Each of these offices is equipped with a computing system for data processing and regional numerical prediction. Further details are in Appendix 2, p. 2-75, 76.

As the volume of data increases, and as data rates get higher, the existing data handling systems will become saturated.

The meteorological communications system is rapidly approaching such a state. Controlled by a mid-1960s generation computer in Toronto that organizes data flowing into CMC, queuing times now are becoming excessively long for data to move from the acquisition site to the CMC. A study is being planned to modernize the system.
Integration of satellite imagery into numerical forecasting has been limited because of incompatibility of data sets. Suitably displayed satellite imagery has been subjectively assimilated into manual forecasting systems, but additional raw radiance data in the form of imagery will do little to improve the quality or quantity of forecast products without the development of technologies to convert such radiances into geophysical parameters.

AES's Special Function Centres include oceans-related activities. Specifically, they are the METOC centres in Halifax and Esquimalt, described under the DND heading, the Beaufort Sea Advanced Base at Inuvik and Ice Forecasting Central in Ottawa.

Ice Central receives data from ice reconnaissance aircraft, and from other aircraft and vessels. Imagery is received from the NOAA satellite, relayed by the Satellite Data Laboratory in Toronto and the Arctic Weather Centre in Edmonton, and from Landsat via the firm ISIS Ltd. which retails satellite imagery received from Prince Albert and Shoe Cove satellite stations. Ice Central generates ice maps and forecast products, and transmits them through AES, DOT and DND facsimile communications facilities. As activities in arctic waters expand, the communication requirements for ice information will multiply rapidly. Ultimately existing facilities will saturate. The solution may lie in the use of dedicated satellite channels.

There is a general trend, motivated in part by the contracting-out policy, and in part by cost recovery criteria, for the private sector to become more involved in the delivery of meteorological and ice services. Such is the case now with most drillships and drill rigs which employ private firms to conduct the mandatory meteorological and oceanographic measurements at each site. Such firms also provide forecast products to the operators - information that is critical to the safe and successful performance of many offshore drilling operations. It seems likely that the trend of increasing private-sector involvement will continue.

2.6.4 Special Issues

Special issues concerning meteorological and ice services appear to be as follows:

- Weather Station Papa ship replacement
- ice reconnaissance aircraft replacement
- expansion and automation of the data aquisition activity.
- the provision of new services for special users

As stated earlier, an interim solution for replacing the ships at Papa has been proposed by AES. Initially, a total of four agencies had an interest in the problem: AES and OAS for physical and biological oceanographic measurements, DOT for search and rescue, and DND for its own purposes. Because it had the greatest concern, AES took the lead and organized an Inter-departmental Advisory Committee with representatives from all interested groups. However, when it came to the point of committing funds, the other agencies declined leaving AES the task of supporting a Papa replacement by itself. This may be the correct resolution of the problem, but the question remains as to how the other agencies will meet their continuing needs at Papa after the AES-only solution is put into place.

The ice reconnaissance aircraft replacement issue described earlier is symptomatic of a general problem related to the planning for major data acquisition facilities. When the costs of such facilities need to be shared between departments, in this instance DOT and DOE, there is no standing mechanism for readily resolving the problem except through arbitration by the Treasury Board Secretariat.

A continuing concern of the AES is the acquisition of data required for the optimum performance of the various AES production systems. The field is characterized by rapid technological change, and automation is a prime objective. The largest portion of the AES ice reconnaissance budget is now devoted to this activity, but additional resources are needed.

The provision of new services for special users raises a fourth issue best illustrated by an example. The Arctic Pilot Project to move LNG by tanker from the Lancaster Sound region to the eastern seaboard will require special weather and ice information products for safety reasons. On a pilot project basis, the Arctic Weather Centre in Edmonton and Ice Forecasting Central in Ottawa should be able to provide the necessary forecast products for the amount of shipping involved.

If the volume of traffic increases, present AES facilities just will not be sufficient. As requirements grow, AES should be expanding its capacity, the costs being borne by the users. However, it is now policy that instead of adding man years and government facilities, departments should contract out to the private sector. The expansion of capacity will take time, because it will involve the installation of local weather stations and other facilities, and so planning should begin early.

Ideally, the private sector should take the initiative in such an instance, but there is a question as to whether the private sector is yet sufficiently mobilized to undertake such a project. Thus it is not clear who should or will take the planning initiative, and since there is a matter of safety involved, the matter is cited as a potentially important issue for the future.

2.7 Other Ocean Service Activities

There are a number of ocean service activities that require or involve the handling of data. They are:

1. Marine Search and Rescue
2. Hydrography
3. Oceanographic Surveys
4. Marine Geoscience Surveys

2.7.1 Marine Search and Rescue

Marine SAR is the prime responsibility of the Canadian Coast Guard. There are three Coast Guard Rescue Officers (CGROs) with associated watchkeeping staff working as marine advisors. Marine SAR incident coordination is performed by them under the overall SAR coordination responsibility of DND, as described in Section 2.5.2.

In the event of a SAR distress incident, immediate information on the vessel's position is essential. This is received primarily from radio contact through the network of 52 manned Coast Guard radio stations, although the Coast Guard Safety Branch has established a requirement for search initiator buoys to be mandatory on certain vessels. The major requirement of the real-time marine SAR information system is in the detection, location and identification of vessels in distress. Other forms of information necessary in SAR operations are the location and identification of other shipping and aircraft which might render assistance including the location and operational readiness of all government search and rescue platforms. Also a knowledge of the environment of the area concerned is important which includes predicted and actual conditions of ice, sea state and weather. Obviously reliable communications are critical to successful SAR operations.

DND have implemented a computerized data system that is being used for marine SAR planning purposes. The Coast Guard is utilizing information from this system in conjunction with data supplied by CGROs to develop a complete archival information package on marine SAR.

2.7.2 Hydrography

The Canadian Hydrographic Service (CHS) within the Ocean and Aquatic Sciences sector of DFO is responsible for the systematic hydrographic survey and chart production activities for coastal, inland navigable and offshore waters. The Service maintains three regional offices responsible for primary data acquisition and a Hydrographic Data Centre (HDC) at headquarters in Ottawa responsible for data handling and the maintenance of the Canadian Hydrographic Data Base (see Appendix 2, p. 2-98).

Essentially five types of data are collected - hydrography, topography, horizontal and vertical control, currents and nomenclature. Auxiliary data comes from such sources as DOE, DOT, DND, EMR and DPW. Data is sent to HDC for processing and compilation for chart production purposes. The advent of microprocessor technology has made possible the use of digital techniques for both acquiring and processing hydrographic data.

Two committee structures are used to transmit requirements for hydrographic services: the Interdepartmental Committee on Hydrography chaired by the Dominion Hydrographer, with representatives from DPW, DOT and DND, deals principally with hydrographic chart construction. Regional committees chaired by regional hydrographers convey special requirements for new surveys.

While DOT often has been able to provide ships to aid CHS in meeting DOT's needs, resource limitations and the time required to conduct surveys have prevented CHS from meeting all requirements, and much of Canada's navigable waters, particularly in the arctic, have not been charted. Also some existing charts need revision, such as certain regions near Newfoundland. A faster and cheaper method for conducting hydrographic surveys is acutely needed.

A new technique for performing hydrographic surveys from an aircraft is in the experimental stage. Essentially it entails the use of conventional topographic mapping of the seabed using a regular survey camera, taking into account the change in refractive index at the air-sea interface, coupled with a highly-accurate track recovery inertial navigation system that records the position and attitude of the aerial photograph to an accuracy sufficient for bathymetry and charting purposes. Obviously the technique is only valid for waters sufficiently shallow that the bottom can be seen on the aerial photographs for contouring purposes. Such a limitation still permits large areas of the relatively shallow waters in the arctic to be surveyed. If the technique is proven in practice, it could save the Canadian Hydrographic Service considerable money and time in covering those regions which will soon be used for the transportation of resources, people and equipment into and out of the arctic.

2.7.3 Oceanographic Surveys

The oceanographic portion of the Ocean and Aquatic Sciences (OAS) program in DFO is concerned with physical, chemical and biological research, and provides marine data services to meet a number of national and international requirements. The research program supports all of the ocean management functions, as do marine data services in the form of real time support to marine operations and research, historical databanking, analysis and product services for baseline studies, and engineering studies. OAS conducts systematic oceanic surveys which provide engineering data necessary for safety regulations, and for non-renewable resource exploration. Various international activities concerned with use of the seabed, renewable resources and marine environmental problems contribute directly to the international ocean management function.

For data acquisition, OAS operates a fleet of 11 major ships and 230 smaller ships. These vessels are used by CHS and OAS research staff to support the data-related ocean management activities of OAS. OAS also operates a Tide and Water Level Data Network consisting of approximately 140 permanent water level gauging stations in navigable waters in and around Canada. End products of this network include the Canadian Tide and Current Tables and water level statistics which are required for the design of marine facilities.

The wave climate study of OAS collects measured wave data at about 20 locations in and around Canada each year. About 50% of the data is gathered in support of design and construction of marine facilities by DPW. Most of the remaining data is collected in cooperation with industry at locations where exploratory drilling is proceeding, or where environmental studies are being conducted for the preparation of environmental impact statements.

Regional programs also support those environmental studies essential to the EARP and fisheries management programs, including salinity-temperature-depth measurements, current meter, water level surveys and other types of physical oceanographic surveys. Examples of this type of support are the cruises being operated for the Flemish Cap International Experiment. The Marine Ecology Laboratory of OAS carries out biological and ecological research and data collection in support of renewable and non-renewable resource management. The Canadian Ocean Data Buoy System (CODS), a family of data buoys developed by Hermes Electronics Ltd., is a joint DFO, AES and NRC program. CODS buoys are being used in the FGGE program, and are planned to be part of the Ocean Station Papa ship replacement program.

A variety of satellite imagery is being used by oceanographers for research purposes. The radar imagery from Seasat is stirring a lot of interest because of the complex surface patterns uncovered by the radar. If such data can be properly interpreted, satellite radar may be a valuable data acquisition tool for oceanographers in future. Satellite retransmission of data from data collection platforms has started recently, and OAS is preparing data products for use by the managers of the Flemish Cap and FGGE international experiments.

Data handling, storage and retrieval is performed in OAS by the Marine Environmental Data Services (MEDS). MEDS maintains

Ocean, Surface Wave and Water Level data bases. The Ocean Data Base is Canada's file for physical/chemical oceanographic data collected in the cruise/station (vertical array) mode. The Surface Wave Data Base is a file of measured wave data from locations around Canada's coastline, the Great Lakes and certain other lakes, and the St. Lawrence River. The Water Level Data Base is Canada's national file for water level measurements collected around the ocean coasts, the Great Lakes, the St. Lawrence River, Estuary and Gulf, and the Fraser River.

Major regional holdings include meter data collected by OAS programs; chemical data collected by the marine chemistry programs, east and west coasts; and biological and ecological data collected by the Marine Ecology Laboratory. More details are available in Appendix 2, p. 2-98.

2.7.4 Marine Geoscience Surveys

EMR's Atlantic Geoscience Centre at the Bedford Institute of Oceanography (BIO) acquires offshore geophysical survey and geological sample data during cruises on BIO and chartered vessels. The data is needed to support research programs and mapping for mineral resource determination and offshore terrain evaluation. Data is maintained in manual archives, but shortly will be transferred into a digital data bank using the BIO computer. Similar activities are pursued by the Pacific Geoscience Centre at the Institute of Ocean Sciences, Patricia Bay, B.C.

2.8 International Ocean Management

International ocean management refers to the exercise of all other ocean management functions in areas beyond Canadian jurisdiction. In this context, Canada participates in various international ocean service and management support activities such as multinational meteorological and oceanographic projects, and also in numerous management organizations such as IMCO and NAFO. Obviously the outcome of the Law of the Sea conference will have a significant impact on Canada's international ocean activities. The following paragraphs examine briefly the international implications of the six basic management functions.

2.8.1 Renewable Resource Management

It is possible that Canada may become responsible for management of the entire continental shelf which extends in some instances beyond 200 miles from shore (e.g. Flemish Cap). Such an extension would place further demands on the information systems supporting this management function, particularly fisheries surveillance and FLASH. The management of anadromous species such as salmon also goes beyond the zone of Canadian jurisdiction. Finally, renewable resource management activities have led to boundary disputes with the U.S., notably at Georges Bank. This might give rise to special monitoring needs calling for more resources.

2.8.2 Non-renewable Resource Management

The Law of the Sea Conference could lead to the creation of an International Seabed Authority which could place demands on Canada to contribute technical and management skills to the international management of the deep seas. The mining of deep sea nodules could become an issue if Canada is called upon to exercise stricter regulatory control over Canadian firms involved in such mining. Another issue is the oil and gas rights in disputed boundary areas in the Beaufort Sea and at Georges Bank.

2.8.3 Protection of the Marine Environment

A major issue that has not yet been fully resolved is whether or not the Arctic Waters Pollution Prevention Act will be fully observed and recognized internationally. Another issue is whether and when Canada adopts international conventions for the prevention of ship pollution - a subject covered in the study of Part XX of the Canada Shipping Act. Also there are a number of issues under the heading of trans-boundary pollution, particularly in the Beaufort Sea where a major blowout incident could result in large quantities of oil impinging on the Alaskan coast, or in the eastern Arctic where a VLCC incident involving the spillage of oil could reach the Greenland coast.

2.8.4 Development and Control of Navigation

Canada's marine navigation aids are closely integrated with those of the U.S. Since Loran A is being phased out in the U.S., and since many of Canada's fishing vessel owners cannot afford Loran C receivers (let alone GPS receivers in future), Canada has had to pick up the costs of the Greenland Loran A station. Canada does operate a Loran C station for the U.S. on the east coast, and another station is being proposed for

Labrador. As the fishing fleets switch over to Loran C, the Labrador station should provide adequate coverage for all of the Labrador coast down to the Grand Banks where the coverage exists today.

By the mid-1980s, the GPS should be in full operation. There is a question as to whether and how Canadian vessels can have access to this more modern system that covers all of the globe, and the availability of a sufficiently low cost receiver. The answer to these questions lies entirely in the hands of the U.S.

Finally, there is the question as to whether and when Canada satisfies protocols of international standards for ship safety at sea - another issue included in the study of Part XX of the Canada Shipping Act.

2.8.5 Defence

Maritime Command's zones of activity in the Atlantic, Pacific and arctic, by agreement with the U.S. and Canada's NATO allies, extend far beyond the 200-mile limit. In the military sense, the degree of integration with the U.S. and NATO fleets is total, and includes classified activities and information systems.

2.8.6 Ocean Services

The mandate of AES includes participation in international organizations and programs such as the World Meteorological Organization and the United Nations Environmental Program. The AES has been active in the implementation of WMO's

World Weather Watch concept, and this continues to be the best way to receive the full benefits for Canada of international meteorological data acquisition, processing and communications. The AES connection to the World Meteorological Centre in Washington described earlier symbolizes the two-way connection of the Canadian meteorological information system to the world system consisting of the Global Observing System, the Global Telecommunications System and the Global Data Processing System. Canadian policy is to make full use of all scientifically and operationally acceptable processed data from WMC (Washington), not duplicating the production of such items, and adopting other products where feasible. Also AES participates in international experiments such as FGGE.

It is important to note that Canada relies heavily on US weather satellites. The US has claimed that such satellites will always be directly accessible to Canada and other nations because of the US commitment to WMO and the Global Observing System, despite the ominous signals that nations may not have direct access to US resource satellites in future, but will have to purchase the data from US agencies.

For ice information service, under international agreement, Canada makes use of information from the US Coast Guard International Ice Patrol on icebergs in the shipping lanes of the northwest Atlantic south of latitude 48°N. Also Canada exchanges ice data with the US Coast Guard and Department of Defense for all waters shared by the two countries, and shares data with other nations that have an interest in ice.

For marine search and rescue, Canada makes use of the US Coast Guard's AMVER system (Automated Mutual-Assistance

Vessel Rescue System) - a data bank and computer that calculates positions of participating vessels by dead reckoning. Merchant vessels of all nations are encouraged to participate by sending details and plans upon departure from port, and periodic position reports en route, to the AMVER Centre on Governor's Island, New York harbour. SAR authorities can interrogate AMVER for the nearest vessels to a marine incident. The system provides such valuable SAR data as each ship's radio watch schedule and whether the ship carries a doctor.

Canada is now participating with the US and France in the experimental SARSAT program, with feasibility testing of one satellite and two earth terminals scheduled for 1982. An operational SARSAT system of three satellites would provide coverage over Canada approximately every four hours. The satellite will carry detectors for ELT and EPIRB signals.

In oceanography, Canada participates in a number of international programs. They include the Integrated Global Ocean Station System (IGOSS) which involves the provision of temperature-salinity profiles reported in real time via ship's radio to the Global Telecommunications System, the Flemish Cap International Experiment and the FGGE drifting buoy program. As a member of the International Oceanographic Commission, Canada contributes data to the World Data Centre. Of course, Canada also meets its international responsibilities by providing hydrographic charts of navigable Canadian waters for use by all mariners.

3. ISSUES RELATED TO DATA ACQUISITION AND HANDLING FACILITIES

One of the principal issues of the study is the relationship between technology and demand. The rapid acceleration of new technologies, particular in space, electronics and computers, is causing existing equipment and techniques to become obsolete very quickly. Demands can be created that result from additional or new capabilities the technology can provide. Extended capability often is needed, but in some instances demand gets stimulated by the technology itself either to fulfil a desired capability, or to satisfy a drive for maintaining pace with others. Demands so stimulated have been defined as "technology push" where those responsible for providing technology drive the R and D programs and procurement processes based upon what technology can do more than what is required.

Ideally, needs should be the prime driving force behind any decision to add new capability. Responsive technology is then being pulled by demand. In "demand pull" situations, technology is the faithful servant, in contrast with pure "technology push" where technology is the undisputed master.

In practice, it is impossible to avoid a degree of technology push. Demand (what is wanted and ultimately what is bought) is influenced not only by need and price, but by what is available in the marketplace. It is often difficult to identify the component of demand that arises solely from need, for in the longer term needs are affected by what is available, and thus by technology.

A fundamental principle to be followed in the planning process is to minimize technology push by making technology respond solely to needs, and to economic forces in the market-place through the ability of technology to lower costs. Based on the maxim that "necessity is the mother of invention", needs must be made known to mission-oriented R and D agencies, the programs of which determine at a later time what technology will be available.

Ocean information system needs were examined in the previous chapter, and are described in more detail in Appendix 2. The following paragraphs examine R and D, procurement and operations as they relate to needs and the system design processes. Also, some special issues are addressed concerning policies which could affect Canadian needs, and some economic considerations which should be woven into the fabric of the planning, design and operational programs.

3.1 Research and Development

Table 3-1 summarizes major ongoing and anticipated interdeparemental ocean information system technologies, most of which are either being funded or are in the stage of requesting funds. Ocean information system R and D historically has been, and in many cases will continue to be done by individual departments. However, because of cost, complexities and the possibilities of serving a variety of needs, such R and D is tending to become more interdepartmental in the interests it serves, as illustrated by Table 3-1.

As espoused above, R and D should be responsive to needs and thus it is essential to identify, assemble and disseminate the needs of departments to R and D performers in government, universities and industry in some regular and systematic fashion. Having identified needs and the necessary R and D programs to fulfil them, the problem usually is to find R and D funds. This becomes particularly difficult if sources must be found from several departments, especially during periods of financial restraint. However, there are a number of government programs and special mechanisms for funding R and D that could be of velue for ocean information systems.

In addition, R and D conducted abroad could be of importance to Canada, and there is a need to monitor it in order to reduce the chance of duplication, and to take advantage of that which is relevant to Canadian needs.

In the paragraphs below, the following issues related to R and D are covered:

- assembly of needs across departments and making them known to the appropriate agencies

- R and D funding mechanisms

- the problems of funding R and D that spans the interests of more than one department

- monitoring of R and D activities performed outside of Canada.

3.1.1 Assembly and Dissemination of Information on User Needs

There appears to be no regular system whereby needs are assembled and correlated for all departments involved in ocean management. A correlation of needs could reveal important areas requiring early attention. Also, if R and D is to yield new technology that is relevant, requirements need to be made known to performers both in government and the private sector.

In the oceans management regime, each department can be expected to conduct or direct its own R and D programs pertinent to its own needs. However, relevant science and technology (S and T) areas may fall between mandates, may be included in the mandates of several oceans-related departments or may be the responsibility of non-oceans departments. CRC, CCRS, and NRC, are not normally part of the oceans management regime. Consequently, S and T requirements, for example, in communications, not dealt with by individual oceans-related departments, have seldom been made known sufficiently far in advance, if at all, to the potential government performers, let alone the universities and the private sector. Responsive R and D programs could not be planned.

In future, R and D planning for ocean information systems could be made far more effective if user needs were made known to R and D performers. Within government there are no adequate or regular mechanisms for making future needs known to government technology agencies such as NRC, CRC and CCRS.

In addition to glamorous space-related technologies, there are a number of more mundane but nonetheless important problems associated with communications, sensors (for example, ice thickness), data handling, processing and storage which such agencies could address if contact with them could be made at a sufficiently early time.

The same applies in an even stronger way to the information systems supply industry. The array of industry R and D incentive programs listed below could lessen the funding problem. Also there may be some requirements that have a broader application than in Canada alone which would open the door for export-related R and D support. The DSS R and D Bulletin distributed to a wide range of industrial R and D performers provides an excellent means of making short term needs known to industry. However, longer term requirements must be made known as well, but no mechanisms have yet been put into place.

In recent years, there have been three separate exercises to assemble oceans information requirements from departments in the oceans management regime - a partial compilation for DND's study on civilian uses of the LRPA in 1974, the Surveillance Satellite Task Force in 1976, and the current study (appearing as Appendix 2). The purpose in each case was not to influence R and D directions, but rather to examine other policy issues, and so the compilations have not been of significant detail for R and D planning purposes. Nevertheless, they do give an indication of what is needed, and requirements of individual agencies.

During the present study, neither industry* nor provincial and municipal government ocean information needs were systematically assembled because of limited time and resources. For R and D considerations and long-range planning the needs should be taken into account, because alongside federal requirements, such requirements could tip the balance when decisions are needed to commit R and D resources. The present study is not intended to recommend specific R and D programs - only the processes needed to plan them.

3.1.2 R and D Funding Mechanisms

When long-range planning reveals a need that cannot be fulfilled by available technology, there are a wide variety of mechanisms available for the funding of R and D in government and industry. They include:

a) Departmental Budgets - Over the long term, it would be expected that departments with future requirements for new technology should be responsible for funding the necessary R and D from their annual appropriations. The contracting-out policy has provided, since 1972, that new requirements for mission-oriented research, development and feasibility studies in the natural sciences be contracted-out to industry. The loci of R and D projects thus are shifting to industry as new programs emerge, and existing projects draw to completion.

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* However, the Canadian Petroleum Association informed the study group that the industry needs environmental baseline data and environmental conditions (ice, weather, sea state, etc.) around drill sites. They say the situation is more or less manageable now, but significantly increased requirements will come with movement into the production phase.

Departmental budgets often are inadequate to cope with the increasingly high costs (and risks) associated with R and D. In addition, projects in connection with new ocean information system technologies often relate to the needs of more than one department. Both of these factors are leading to an increased frequency of interdepartmental R & D projects, some difficulties of which are enlarged upon below. Fortunately there are mechanisms in place to assist in starting R and D projects in industry, and a range of industrial cost-sharing incentive programs encouraging companies to pursue their own R and D activities.

b) Unsolicited Proposals (UP) Fund - administered by the Department of Supply and Services (DSS) the fund was established in 1974 to finance that portion of proposals, approved in principle, which cannot be funded from the sponsoring department's current appropriation until the sponsoring department can arrange for funds through the normal budgetary process.

To be approved, an unsolicited proposal must meet the following criteria:

i) Sponsorship - The proposal must be sponsored by a department which must consider the proposal to support directly its departmental mission, and to have sufficient priority that the department is prepared to make the necessary budgetary provision for directly generated follow-on costs. The UP fund provides bridge financing from inception up to the point where departmental budgets take over - a period which must not exceed 18 months.

ii) Scientific Merit and Technical Feasibility - The proposal must be judged by the sponsoring department to have scientific merit and to be technically feasible.

iii) Uniqueness - The proposal must be judged to be unique by DSS, to justify waiving the normal competitive procedures. "Uniqueness" can mean either the proposal offers a new and unique idea, or the proposer has a unique capability or capacity for carrying out the proposal.

The proposing company is expected to discuss its proposal with potential sponsoring departments before submission. Each submission is screened by an interdepartmental committee composed of representatives of potential sponsoring departments and other agencies with expertise or interest related to the proposal.

Some departments have expressed a concern that the UP is replacing conventional departmental R and D budgeting. The result would be a certain loss of departmental control over the science budget.

c) Enterprise Development Program (EDP) - replacing a range of earlier programs, the Department of Industry, Trade and Commerce (DITC) established EDP in 1977 to promote growth, efficiency and improvement in eligible manufacturing and processing industries in Canada, such that the companies attain viability within an internationally competitive environment. The program provides:

i) Loans or loan insurance

ii) Grants for innovative projects

iii) Grants for industrial design

iv) Grants to study productivity improvement projects

v) Grants to study market feasibility

vi) Grants to develop proposals for projects eligible for assistance.

The grants are normally provided on a 50% cost-sharing basis. Most relevant to ocean information systems presumably would be the grants for innovative projects. Such projects necessarily would respond to the largest market, and thus be dictated by international requirements which may or may not be similar to specific Canadian needs.

d) Defence Industry Productivity Program (DIP) - administered by DITC, the program was started in 1968 to enhance the technological competence of the Canadian defence industry in its export activities by providing financial assistance to industrial firms for selected projects. Emphasis is placed on those areas of defence technology having civil export sales potential. The Crown normally contributes approximately 50% of the total costs. Assistance may cover the development of products for export purposes, the acquisition of capital facilities, or pre-production expenses to establish manufacturing sources in Canada for export markets. The above comments on the EDP concerning ocean information system requirements apply equally to DIP.

e) <u>Industrial Research Assistance Program (IRAP)</u> - sponsored by the National Research Council (NRC), IRAP was established in 1962 to increase the calibre and scope of industrial research in Canada in situations where this leads to high business effectiveness with economic and/or social benefit to Canada. Financial support is given to research workers engaged in approved industrial research projects of high technical and business merit. The program pays for research workers' salaries and some benefits. IRAP is a program that is intended to attract and help to retain high-quality R and D teams in Canadian industry that might be applied to appropriate ocean information system projects.

f) <u>Program for Industry Laboratory Projects (PILP)</u> - also administered by NRC, PILP has provided since 1974 financial assistance to firms participating in certain cooperative R and D projects with NRC. The objective is to assist in the application of research results from the NRC laboratories to situations where there are important Canadian industrial opportunities. NRC will pay up to full costs as negotiated with the performer from the PILP budget. The collaborating NRC laboratory will contribute in kind (scientific staff, laboratory facilities, etc.).

In June, 1978, funds were made available for departments to initiate their own PILP-type programs. Departmental PILP was renamed COPI, Cooperative Projects with Industry, a program that could be of significant use in ocean information systems R and D because of the large number of related in-house government research projects.

g) Industry Funds - the final important source of R and D funding is industry itself. For industry to provide all the funds, the potential commercial return would have to be sufficiently attractive, but it is possible that some Canadian ocean information system components could meet such a criterion.

Of all the above R and D funding mechanisms, outside of departmental budgets, the two most useful for the purposes of ocean information systems are the Unsolicitated Proposal Fund and the PILP/COPI programs. Both pay up to full costs and provide for direction from the sponsoring agency, so that results are most likely to match the specific needs of departments. The UP has been the key fund used to get new programs started over recent years, and is heavily relied upon. However, the resources available to the fund are finite.

3.1.3 Problems in Funding R and D Programs

Within departmental mandates, there are many R and D programs in ocean information systems and related fields being funded from departmental budgets. However, departments with major operational concerns are not always able to give R & D a high priority because of the need to commit available resources to meeting the demands of day-to-day operations.

For fields not solely related to a single department's mandate such as communications and remote sensing, there are the technology agencies such as CRC, CCRS and NRC. But in satisfying the needs of any one sector such as the oceans management regime, such agencies can only go so far. Other demands on their resources limit the amount of effort that can be devoted to oceans information-related technologies.

Thus there is often a chronic shortage of funds to support ocean information R and D. The R and D to meet a requirement in any one department may be out of the question because of its cost, but if other departments holding minority interests in the same requirement could be mobilized, it might be possible to assemble the necessary resources. Such processes have met with varying success in the past.

One example is in the Canadian funding for the experimental search and rescue satellite SARSAT - a joint Canada/U.S./France R and D project involving the placing of a transponder on a U.S. weather satellite. Great difficulty was found in assembling funds for the Canadian participation amounting to approximately $ 13 million, partly because of the lower priority given by departments for programs outside of departmental jurisdiction, and partly because SARSAT is an experimental vs operational program involving a measure of risk and a limited lifetime. Support came from three departments: DND for 80%, DFO for 8%, DSS for 2% (Unsolicited Proposal Fund); but finally it was MOSST that broke a funding impasse for the remaining 10%. Further support in kind is being provided by DOC.

A second example is the problem of funding the replacement for Ocean Station Papa, referred to in Section 2.6.4. In that case it was not possible to enlist the support of other operating departments, and so AES, with the help of DSS's Unsolicited Proposal Fund, will be the sole sponsor.

The above examples illustrate the difficulty in planning for financial support for joint programs. The problem is magnified for R and D where the results are never certain and it is difficult to assess initially each department's interests and share in the use of the final system.

In the final analysis, the problem is to find a means of processing R and D resources from departments and the other R and D funding mechanisms described in Section 3.1.2 onto the specific needs of Canadian ocean information systems. At present, such processing has been performed by a lead department that varies from one project to the next, with uneven results. To the study group, the current methods of assembling R and D funds for interdepartmental ocean information system projects are not entirely satisfactory, and are in need of a fresh approach where the entire picture can be developed, and individual programs viewed in perspective.

3.1.4 Foreign R and D Activities

Other nations, particularly the U.S., are conducting major ocean information system programs which are of interest to Canada. As described in Section 2.8, Canada participates with other countries in many operational oceans information programs (for example, the Coast Guard, DND and AES have major cooperative programs with the U.S.), and Table 3-1 includes several international programs in which Canada has, or may have, an interest.

The amount of R and D being done by other nations in relation to ocean information technologies bears close watching. By and large, departments do maintain an awareness and close contact with their opposite numbers in countries performing significant R and D. However, as with the funding difficulties described above, for those areas that might fall between, or span several departmental mandates, such as oceans-related satellite and aircraft systems, there is a need to monitor and closely follow developments in order to estimate their value to Canada.

A further reason to monitor foreign R and D is to ensure that Canadian programs are not unknowingly duplicating work being done elsewhere. Moreover, such an international awareness makes it possible to identify opportunities for Canadian industry in the export market - for example, MDA satellite earth station and data processing systems, and the Hermes data buoy program, both of which have found significant ofshore markets.

The rapid acceleration of technology development abroad could place Canada at a disadvantage if other nations gain a greater knowledge than Canada of the natural environment, resources and human activities on, in and under Canada's oceans. For example, the USSR possesses more physical oceanographic data on Canada's coast than Canada; and the U.S. has more environmental and hydrocarbon information on Georges Bank than this country.

In an age of space surveillance, global communications, computers and high-speed data processing, Canada must be concerned about its technological preparedness. Developments abroad can lead to a direct challenge of Canadian sovereignty on and under its oceans if Canadian technology lags significantly behind other nations. Moreover, the long lead time between the initiation of an R and D activity and operational readiness, often amounting to several years, stresses the need for strategic planning and the early formulation of requirements by operating agencies.

3.2 Procurement and Operations

The problems of funding R and D programs spanning more than one department described in Section 3.1.3 apply equally to the funding of major capital facilities. In the case of ocean information systems, major facilities presently requiring inter-departmental funding are mainly data acquisition platforms - satellites, aircraft and data buoys. Other components of the system involving data handling and communications facilities usually have been purchased separately by each operating agency in the past. However, in future they also will become increasingly complex and more expensive, so that procurement and operating costs may have to be shared for them as well.

The problems associated with multi-departmental funding of procurement and operations suggest that alternative approaches be examined. Use of the private sector is an obvious and potentially-viable option. The government has leased aircraft from the private sector for many years (for example, the Electras for ice reconnaissance), and such an alternative may be necessary if the Tracker replacement issue is not satisfactorily resolved. Equally, the private sector might be prepared to lease to the government other data acquisition platforms such as data buoys and even satellites.

Moored data buoys probably would present no problem to a leasing company. Even drifters might qualify, although in this case the problem becomes more complicated because of the uncertainty surrounding mortality rates.

In the U.S., Hughes Aircraft have established LEASAT - a communications satellite being leased to the U.S. Navy. The Tracking and Data Relay Satellite System (TDRSS), discussed as an issue in Section 3.4, is another example in which NASA will lease from Western Union under a fixed-cost lease contract. The TDRSS will also serve another purpose as Western Union's ADVANCED WESTAR domestic communications satellite. The DOC study on MUSAT examined the possibilities of leasing capacity to a wide variety of user departments.

The concept of the private sector leasing satellite capacity to various government departments and other agencies is still in the embryonic stage, but not beyond the bounds of feasibility. However, it may be that the terms required by the private-sector leasing company to safeguard its financial investment may be unacceptable, and too costly to users.

An approach lying between multi-departmental ownership and private-sector leasing is the idea of single-agency ownership wherein user departments rent capacity or purchase data from the owner agency on a cost-recovery basis.

It is evident that there are several options from which solutions might be found to the problems of procurement and operation of data acquisition platforms. There is no common answer and each situation must be weighed on its own merit. However, in all cases it is necessary to identify a lead agency to take the leadership role, conduct what studies are necessary and negotiate with other agencies holding minority interests. A difficulty can arise when there is no single agency with a majority interest. Under such circumstances, the question arises - do such minority interest agencies find separate solutions to their common problem ? No ready mechanism exists to bring them together except TBS when program forecasts are being reviewed. The same situation can arise when minority interest agencies opt out of supporting a major system as in the case of the Ocean Station Papa replacement.

A matter of concern related to procurement is the question of buying Canadian vs. buying offshore, and finding acceptable ways to maximize Canadian content. Aside from the current practice of permitting some premium on Canadian purchases, the only sure way is to make requirements known sufficiently far in advance that there is time for Canadian industry to conduct whatever R and D is required in order to mobilize for the procurement. When what is needed is not available in Canada, last minute procurement decisions can result in compromises leading to the purchase of sub-optimal, off-the-shelf, foreign technology.

For data acquisition and handling systems already in being, the sharing of such major capital facilities obviously should be pursued wherever practical. While satellites, aircraft and data buoys offer a wide range of possibilities for multi-tasking, ships offer the greatest degree of flexibility, at least for certain applications, because of their load-carrying ability, especially for the purposes of some types of research that can tolerate the locations of opportunity provided by a ship on another mission. Some study group members suggested that multi-tasking of vessels for research purposes is not optimum. The Chairman of the Panel on Ocean Management Sub-Commitee on Multi-Tasking subsequently indicated that, while numerous mitigating factors must be considered, efforts might indeed be increased to make government ship schedules known to researchers in order to improve ship utilization in future. (A knowledge of schedules could not always help researchers, since they often want the schedule changed to meet their requirements. While schedule changes occasionally can be arranged on research cruises, it is usually impractical if the vessel is on an operational mission).

The practice of multi-tasking of major government ship and aircraft facilities is under the surveillance of the Sub-Committee. This on-going function might be extended in future to include other major facilities such as satellites, communication and some data handling systems as they become part of the Canadian oceans information infrastructure.

3.3 Cost Considerations

Cost considerations should be introduced early in the planning processes for new ocean information technologies. Indeed, financial and economic objectives need to be set as prime targets in the design and development phases of any new system. Design-to-cost techniques have become standard in the aerospace industry, but such techniques and associated disciplines can be applied to a wide variety of design scenarios including ocean information systems that embody advanced technology hardware and software. Thus, in planning new data acquisition and handling facilities, cost can and should be a major parameter.

Aside from being able to extend or expand capabilities, new technology can make it possible to do the same job, at lower cost. By and large, the study group has found that existing ocean information needs are being satisfied. Even if further capacity or capability were never needed ; however, future technological advances inevitably would make changes attractive because of the ability to lower operating costs.

In order to evaluate if and when new technology should be introduced, cost effectiveness analyses are required. These involve the examination of a wide range of alternatives, because only by investigating a number of options can the optimum or minimum - cost solution be found. In effect, the "best" answer can be found only by bracketing it.

A good example is the determination of the best mix of surveillance platforms involving satellites and aircraft to meet a fixed area of coverage and observation frequency.

This problem was tackled in the Clough study (Ref. 1, Section VB) as part of the present study obligation to conduct a general evaluation of surveillance systems. Based on a very simple model which accounted only for a limited subset of satellite functions, the Clough study concluded that "the satellite-aircraft trade-off seems marginal and inconclusive".

There was no attempt to analyse the problem further in this study because of the large number of cases that would have to be evaluated, probably with the use of a computer. Any serious attempt to conduct a general evaluation would require significant time, resource and computer power. In fact, cost effectiveness studies need to be conducted on a continuing basis because of:

- the complexity of the issues,
- the need to examine the problems in some detail,
- the necessity of developing and continually evolving computer software for the analyses,
- rapid changes in technology, and
- changes of needs with time.

Ultimately, it is probable that the "most" cost-effective solutions and the "best mix" of surveillance platforms exist only at one point in time because both technology and needs are continually changing.

It should be emphasized, however, that the major assumption in cost effectiveness studies is that the objectives are known and desirable, and this is often a difficult assumption to justify on economic grounds.

While cost-effectiveness studies might play an important role in the choice of the least-cost means of performing some identifiable task, the question still remains as to whether or not there is economic justification for performing the task, at that level, in the first place. Questions of economic justification are more properly assessed by the application of broader tools, such as cost-benefit analyses. This technique, however, might be of limited value as a principal management tool because of the problems associated with the estimation of benefits in some instances (e.g. surveillance activities). It is nevertheless essential to assess, to the greatest extent practicable, the relative opportunity costs associated with allocating resources to a particular task.

Finally, under cost considerations there is the question of cost recovery for existing and future systems. The basic principle which should be applied is that, where applicable, the total cost of an identifiable privilege or service or good (i.e. the use of any facility, property or resource) which is provided by the government to individuals or specific groups, and which is not regularly provided to the public at large, should be recovered from those specific groups. Therefore, in the application of this principle, realistic charge schedules that reflect total costs should be established for users of the service.

3.4 U.S. Policies

An important set of issues on data acquisition and handling facilities concerns recent developments in the U.S. In October, 1978, Senator Adlai Stevenson placed before the U.S. Senate Bill S.3589 "to establish an operational Earth Data and Information Service in NASA and for Other Purposes". The chief reasons for the Bill appear to be to authorize NASA to manage an operational remote sensing satellite program for both national and international purposes, and to establish the framework for eventual full cost recovery for satellite data products. The Stevenson bill is yet to be passed, and so its final provisions are not known.

The U.S. plans to eliminate its satellite command network and on-board tape recorders in future resource satellites through the use of the Tracking and Data Relay Satellite System (TDRSS) which will relay all data from future resource satellites to a central receiving station in the U.S.*. All subsequent data and information products for U.S. domestic and foreign users will have to be purchased through the new Earth Data and Information Service proposed in the Stevenson Bill.

The consequences to Canada of those proposals are that Canada's earth stations at Shoe Cove and Prince Albert would become obsolete. In future, Canadian users would have to pay U.S. charges for readout, processing and communications costs and, in addition, non-recurring costs to recover U.S. investments in capital and R and D. Such charges could become

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* At present, the TDRSS contains a design fault that makes it susceptible to foreign jamming. There are plans to correct the fault through a costly redesign. The question of security of TDRSS communications is still not fully decided.

excessive. Also Canada would no longer have assured access to all Canadian data. It is clear that Canada needs to develop a position and come to terms with the U.S. on these matters. If a satisfactory resolution is not possible, the Canadian SURSAT program would remain as the only secure means of obtaining earth (and oceans) data on Canada from space.

Following the demise of Seasat* on October 9, 1978, (for which Canada has developed earth station receiving facilities), the next U.S. oceans satellite currently in official plans is the National Oceanic Satellite System (NOSS) likely to be launched by Shuttle in 1985. It will carry a strong heritage from Seasat, Nimbus and Tiros-N and have a planned lifetime of 5 years. Probably, the potentially most useful sensor to Canada on Seasat was the synthetic aperture radar because of its ability to penetrate clouds and darkness. It is not known yet whether NOSS will carry such a radar.

3.5 Other Issues

a) Archival Ocean Data

Data acquisition and handling facility issues discussed so far in this chapter mainly relate to the real time, on-line systems described in Section 2.

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* During its 106-day period of operation, Seasat circled the earth 14 times daily, covering 95% of the global ocean area every 36 hours, and completing 1503 revolutions of the earth. It relayed a massive amount of information on surface winds and temperatures, currents, wave heights, ice conditions, ocean topography and coastal storm activities.

However, archived data is no less important to the ocean management regime, as concluded by the study group subcommittee which reviewed archival ocean information systems. The report of this working group appears as Appendix 3. The group draws attention to the need for greater interdepartmental coordination of data gathering and processing procedures in order to minimize unnecessary duplication and future incompatibilities in hardware, data bank contents and data formats. Recognizing that a large proportion of information stored in archival systems originates in real time systems, the group recommended the development of systematic archiving criteria and the use of archiving requirements in planning data processing procedures. Concern was expressed that when changes are planned in data acquisition systems or procedures, compatibility be maintained between new data sets and data already archived. The group also saw the need for an ocean information referral service to maintain an inventory of where ocean information is stored, and how it can be accessed.

b) Interdependency of Operational Decisions

A final issue relates to the interdependency of operational decisions, where the possibility exists that unilateral decisions made in one agency could affect the operations of another. A good example is the Tracker aircraft, where DFO and the Coast Guard are extremely dependent on DND. A decision by DND to alter its flying patterns would have an impact on the other agencies; and equally, if for example DFO decided to turn to a private contractor, instead of relying on the Tracker, the Coast Guard would probably be adversely affected. Such interdependencies suggest the need for some type of coordinating mechanism for ocean information systems, not to perform any executive action, but strictly to ensure that each agency involved knows and understands what the others are planning.

TABLE 3-1 (Page 1 of 4)

SOME OCEAN INFORMATION SYSTEM TECHNOLOGIES REQUIRING INTERDEPARTMENTAL FUNDING

1. SURSAT	R&D project including Canada's SEASAT participation, airborne Synthetic Aperture Radar (SAR) experiments*, development of digital processing techniques for SAR data; projected 3-year expenditures of $ 6.4 million with contributions from 9 departments; major contribution of about $ 2 million from Unsolicited Proposal fund.
2. SARSAT	joint Canada/U.S./France R&D project involving the placing of a transponder on U.S. weather satellite for detection of Search and Rescue emergency transmissions; expected launch - 1982; estimated Canadian program costs about $ 13 million, about 80% of which will come from DND, other contributions from DFO, MOSST, DSS and DOC.
3. CODS	continuing R&D program on development of data buoy technology; initial funding by Unsolicited Proposal (U.P.); further funding by NRC (including PILP mechanism), DOE, DFC; COPI mechanism expected to be used; total cost from 1975-80 approximately $ 4.7 million.
4. Ocean Station Papa Replacement	acquisition and operation of systems to replace weatherships at Ocean Station Papa. AES plan is to instal 3 automatic weather stations on W. coast; operate a network of drifting buoys between Station P area and the coast, the development to be funded by UP from Hermes Electronics Ltd.; and establish a GOES receiving station and Meteorological Data Analyses System in Vancouver through a UP from MacDonald Dettwiler and Assoc. Ltd.

* see Surveillance Satellite Project, Experiment Plan Part 1, Request for Proposals for Experiments, September 1977 - Ref. 4.

TABLE 3-1 (Page 2 of 4)

5. MUSAT	multi-purpose UHF communications satellite proposed by DOC; presently in program definition phase; projected 1984 launch date; decision on project will depend on firm user commitments; DND requirements could account for about 50% of use; preliminary cost estimates of space segments - $ 79 million in 1978 dollars.
6. DASH-7R	aircraft now being designed with EDP funding of approximately $ 6-8 million; DOT and AES may acquire and use for ice reconnaissance; pollution surveillance has been suggested as option in DOT study on Part XX of Shipping Act.
7. Tracker replacement (or lifetime extension)	decision required in 1-2 years; decision involves DND surveillance policy and continued support of civilian agencies; Policy decision is dependent on DND requirements; as long as DND operates Tracker, multi-tasking is dictated by cabinet decision.
8. LRPA civilian pod	Aurora is capable of retrofitting with civilian remote sensing canister; sensor suite options had been discussed in 1974 but interdepartmental funding arrangements were not agreed to; option requires re-examination if it is to be pursued and departments concerned were to make funds available.
9. Airborne oil-spill detection and tracking package	array of sensors has been developed by CCRS with AMOP funding; project has been taken through R&D stage but no funding has been committed to put into operation; system could possibly be part of Aurora civilian pod referred to above.
10. Surveillance Satellite System	SURSAT program was part of evaluation of feasibility of surveillance satellite system; options discussed have been for Canadian system or Canadian participation in international system, the latter appeared to be much more favourable; previous estimate of up to $ 263 million for all Canadian system is now considered low.

TABLE 3-1 (Page 3 of 4)

International Satellite Programs of Interest to Canada

a) National Oceanic Satellite System (NOSS) - U.S.A.: oceanographic and meteorological sensors, possibly SAR, to be launched in 1984.

b) Coastal Oceans Monitoring Satellite System (COMSS) and Land Applications Satellite System (LASS) - European Space Agency: now in early definition phase; would have SAR: possible launch in mid 1980s.

c) Ice Processes and Climate Satellite (IPACS) - U.S.A.: 1985 launch; to measure global ice parameters.

d) System - 85 - USA; 1985 launch; operational meteorological satellites to replace GOES and NOAA satellites.

e) Clipper Bow - U.S. Navy radar satellite; 1983 launch.

f) MOS-1 - Japanese; 1983 launch; visible, infrared and microwave sensors.

g) Tracking and Data Relay Satellite System - USA; first launch 1980; replacing NASA Command network and on-board tape recorders; will relay data from all U.S. earth observation satellites to central facility for processing and distribution to users.

TABLE 3-1 (Page 4 of 4)

Other Ocean Information System Technologies Being Studied

a) Mini Remotely Piloted Vehicles (RPVs) significant research under way in U.S.: low level of Canadian R&D at present; could have good potential for many tactical missions.

b) Airships

use as surveillance platform has been examined by DFO; increasing interest in U.S.

c) Shore-based observation radars

used in U.S. for long range tsunami and hurricane observations, surface waves and currents.

d) Operational drifting buoy systems that may develop from FGGE.

e) North Atlatic Ocean Station (NAOS) - international weathership program.

4. FINDINGS

As a result of its meetings, field trips and briefings, the study group reviewed the issues and problems described in Chapters 2 and 3. The analysis can be summarized as a series of findings grouped under the major issues that have emerged during the study. The findings are listed below.

4.1 Needs

a) Present information needs have been stated by federal users, based upon current management functions. They claim that, with few exceptions, such needs are being satisfied, or that plans are underway to satisfy them. Needs so stated are tempered by what information can be obtained with available technology.

Needs not currently being satisfied include ice research (ice strength, iceberg statistics, movement and scouring, ice dynamics, etc.) although such work is being planned at Burlington; more extensive offshore environmental baseline studies and site-specific data are required for regional planning.

b) Future information needs stated three years ago for the period 1980-2000 have shown little change, according to the update on departments' anticipated ocean surveillance requirements. However, needs could expand or intensify as new or more detailed information becomes available through new technology. Also needs could change rapidly as new operations are planned and initiated, such as the transport by sea of oil or natural gas, offshore production or an expanded offshore fishery.

c) Neither provincial and municipal government nor industrial needs have been collected during the study because of time limitations; however, there are potentially important links to federal requirements, and such needs should thus be assembled in future.

d) Policy makers and management are major users of ocean information. The working group on archival ocean information systems found that archived ocean data/information is a vital element of the foundation upon which the entire ocean management regime is based. The needs of management thus determine, in part, what data is archived; conversely, archived data plays a major role in policy making and management processes.

4.2 Technology

a) While user groups generally are aware of new technologies being developed elsewhere relevant to their potential future needs - for example, the sensors on Seasat, there is no ready mechanism for jointly acquiring high-cost capital equipment such as data acquisition platforms that cannot be afforded or justified by a single department.

Even with existing capital facilities, some of those interviewed claimed that multi-tasking is not optimum with respect to the use of ships for research purposes.

b) While platforms, sensors and ground stations represent high-cost components that often can be shared, the main expense in many instances is in the conversion and filtering of raw data into usable form.

c) In future, satellite communications facilities may need to be shared as needs expand, particularly in the arctic where atmospheric and ionospheric conditions can block radio communications for hours and sometimes days.

e) Government technology agencies such as CCRS, NRC and CRC, and industry, have not always been made aware of R and D needs in ocean information systems adequately early enough to affect their long-range planning.

4.3 Ocean Information Systems

a) While information is shared from major data acquisition platforms such as the Tracker aircraft which performs surveillance missions related to defence, fisheries and marine pollution, ocean information systems are, by and large, independent and serve mutually exclusive management functions. The principal systems operating on-line in real time are:

i) AES-meteorological, oceanographic (METOC) and ice reconnaissance services

ii) Defence surveillance

iii) Search and rescue

iv) Vessel Traffic Management

v) Fisheries - Foreign Licencing and Surveillance Hierarchial Information System (FLASH)

vi) Ocean pollution surveillance.

Each system contains its own communications, computer, data processing, storage and readout facilities. Sharing occurs principally with the use of data acquisition components including platforms, sensors and ground stations.

b) There are essentially three departments that maintain integrated operations centres: DND which includes surveillance operations (also supporting fisheries and source pollution monitoring), METOC and SAR; DOT which includes ECAREG, VTM, ice monitoring and oilspill countermeasures; and DFO for fisheries surveillance and management. In addition, AES operates meteorological and ice operations centres to service the entire oceans management regime. There was no evidence to indicate a need for greater centralization; however, the high costs and greater data rates of new technologies may force further integration in the future.

c) Despite the decentralized character of the real time systems listed above, evidence reviewed by the study group showed no duplication of any significance. Presently, departments seem satisfied with linkages between their respective systems which the study group found to be quite effective, though often informal.

d) In some instances, notably with AES meteorological services and certain aspects of search and rescue, the land-ocean boundary is spanned and such systems serve wider interests beyond just those associated with the oceans.

5. CONCLUSIONS AND RECOMMENDATION

The first two terms of reference outlined in Section 1.3 call for an identification of data requirements and a review of major data acquisition and handling systems, existing and planned, over the next decade. Appendix 2 responds to these terms, listing in detail surveillance requirements under each management function, and describing real time and archival information systems operated by those departments with ocean management responsibilities. Existing and planned data acquisition and handling systems and the issues that surround them are the subjects covered in Chapter 2.

The third term of reference calls for a determination of possible technical and management options in the meeting of data requirements, and an evaluation of the potential for sharing common facilities in order to allow Canada to meet its ocean management objectives for the 1980s. The objectives for ocean management are expressed through the various Acts and Regulations pursuant thereto that in aggregate form the Oceans management regime. The objectives are being met through a departmental organization structure reflecting such legislation. Thus there is basis in law for each of the ocean management activities performed by departments and examined by the study group.

Management options that might have been studied include alternative departmental distribution of management activities necessitating changes in legislation, and various organizational structures that could solve specific problems or resolve certain issues that have been uncovered in the study. The

Steering Committee instructed the study group not to deal with management structures, but to concentrate on issues and principles. Thus the management options examined were those of function, rather than of form.

The issue of technical options was considered by the study group and examined in more depth in the Clough study. It became apparent very early that such studies and the cost effectiveness analyses that must accompany them need to be conducted in greater depth and with more resources than were available to the study group in the time available. It was a finding that current technical solutions are generally adequate for the near term, and that major changes are not likely to be needed until mid-1980s. However, technical options examined today would be woefully obsolete in five years time because of changing technology and needs. The study group concluded that adequate resources will have to be devoted in future to the study of technical options and cost effectiveness, and that mechanisms are needed for such studies to span departmental lines, and be done on a continuing basis.

A further requirement placed on the study group was to conduct a general review of surveillance systems with particular emphasis on Seasat. The review of surveillance requirements included in Appendix 2 is the result of a survey performed by the study group secretariat which updates an earlier examination performed by the Task Force on Surveillance Satellites. At the request of the study group, the Clough report addressed aspects of the surveillance review including a brief examination of the optimum mix of surveillance platforms. The present study terminated too early to evaluate the results of Seasat - a task that is being performed through the SURSAT Project Office. Since surveillance systems form a major part of the total ocean management regime, the paragraphs that follow deal with most of the related issues. However, surveillance systems as such are not singled out under a separate heading.

The following sections embody the conclusions of the study group, structured under headings related to the major issues of the study. They lead to a single recommendation.

5.1 Assembly of User Needs

With some exceptions, present ocean management information needs are being fulfilled, or plans are in place to fulfill them. However, there are a few problems for which solutions are being sought in connection with the surveillance platforms used to meet these needs: the life extension and ultimate replacement of the Tracker and ice reconnaissance aircraft, and the ships at Ocean Station Papa.

Future needs may tax existing systems, particularly as the volume of needed data flow expands and new data collection platforms become available (through future U.S. or Canadian satellites, for example). Under such circumstances, a "data utility" feeding data to a wide variety of users could become a practical necessity.

Requirements for oceans data and information are continually changing with time. There presently is no formal or regular means of assembling such needs on a government-wide basis and disseminating them among those that should be aware - industrial and government R and D performers, operating departments and crown agencies, operating companies, etc. Needs so assembled should be assessed as to which are being met, and whether there are serious gaps.

5.2 New Technology

The principle areas of new technology being pursued in Canada for ocean information systems is the use of radar on space and aircraft platforms, and the general applicability of remote sensing for a variety of applications including the detection of pollution, and mapping of oilspills. It is too soon to evaluate the results and their applicability to Canadian needs, but early indications are encouraging. Thus it is reasonable to conclude that future surveillance systems will involve satellites, have all-weather capability and involve more extensive use of sensors on board aircraft.

There is a continuing need to monitor and audit new technology and developments relevant to ocean information systems being created elsewhere - mainly in the U.S. and Europe. Foreign developments related to platforms and data gathering systems are especially important because Canadian participation may be the most cost effective way for this country to achieve certain of its ocean management objectives. Information on these and other technologies related to data handling also will be of value in planning future Canadian systems.

Policies emerging in the U.S. should be of particular concern to Canada (as described in Section 3.4). While resource and oceans satellites have not yet proven themselves to be of operational value to the ocean management regime, they nevertheless are showing promise. It is reasonable to anticipate that such satellites will come into limited operational use sometime during the 1980s. Thus Canada needs to develop a position and come to terms with the U.S. at the earliest possible time in respect to Canadian access to future satellites like Seasat and its successors. Otherwise, the user cost structure and distribution system now proposed by the U.S. could be prohibitive for many Canadian operational user groups.

5.3 Degree of Integration

The organizational arrangements whereby Canada exercises its ocean management responsibilities results in each department operating its own information systems and co-operating with others as needed - formal links as necessary, informal in the field. Thus there is no single, integrated ocean information system at present whereby departments share a common ocean data acquisition and handling facility, and some departments would resist any effort for greater integration. However, the fulfillment of future needs and the more efficient fulfillment of current needs with new technologies may require some adjustments in the degree and form of integration.

At present there appear to be no compelling reasons to integrate existing systems further since, as Finding 4.3(c) indicates, there appears to be no significant duplication, and since the systems interlock as necessary. In future, integration probably will occur mainly with respect to data acquisition platforms and related subsystems where multi-tasking is the only economic solution, as is already the case in the multi-purpose use of the Tracker, and indeed in civilian applications of the DND system as a whole.

New microprocessor and computer technology permits and encourages decentralized data processing, storage and display - certainly at the data rates now encountered and anticipated in the near future. The introduction of very high data rate spacecraft sensors toward the end of the next decade may necessitate some integration of currently decentralized data handling facilities, but it is too early to estimate how and whether this will impact current systems now in place.

5.4 Necessity for Joint Action

Joint action by agencies responsible for ocean management functions is seen as imperative concerning the planning, R and D, procurement and operation of future data acquisition platforms and related subsystems. The long lead time for R and D and the acquisition of major facilities (upwards of 5 to 7 years) makes joint departmental long-range planning essential. Otherwise, Canada could find itself forced to purchase offshore when the time comes for critical selection.

R and D on future data acquisition systems needs to be supported and fostered, but since many future systems likely will serve the interests of several departments, no one department can be expected to cover the costs. The same can be said for procurement costs and other non-recurring expenses.

An alternative to government operation of data acquisition systems is to lease from the private sector. Although leasing does conform to the contracting-out policy, its financial implications in particular circumstances need to be carefully assessed.

5.5 The Future

The general impression left after the briefings and field visits was that all agencies connected with ocean management expect substantial increases in their future information needs as major events unfold in the oceans sector. Over the 1980s, the following major events can be expected to impinge on the ocean management regime:

- expansion of offshore exploration leading to oil and gas development and production,
- the transport of significant quantities of oil and gas out of the arctic, and
- increased domestic offshore fisheries activities, particularly in ice-infested waters.

With the advent of offshore production, information requirements for non-renewable resource management will increase dramatically. The transport of hydrocarbons through arctic waters will require en route navigational way systems and support services to expand, including aids to navigation, icebreaking and communications facilities. Also marine emergency response capabilities will have to increase, including marine search and rescue operations. Extended domestic offshore fisheries in Labrador waters where ice is encountered, and in traditional fishing grounds, and the expected future need to establish stock management programs in areas outside the 200-mile zone, such as the Flemish Cap and the Tail of the Banks, will mean an increase in the data needs for renewable resource management.

All of the above activities will require broader coverage and more local meteorological, ice and oceanographic services which will impose greater loads on existing data collection, handling and communications facilities. In addition, greater capacity will be required for pollution monitoring and counter-measures activities. A major increase in the collection of environmental baseline date can be expected.

In examining the future information needs of any one department or agency, the requirements do not seem too imposing. However, viewed in aggregate, it becomes evident that in the 1980s, Canada will encounter a rapid upswing of the growth curve in terms of ocean management information volume. Technology is keeping pace with the need for more information, and thus an apparent equilibrium exists between technology and need. Such a coincidence may be the result of technology push, but the volume of information needed is related to the progress of ocean-related events described above, not to the advent of new technology.

The requirements for data from remote locations probably can be met most cost effectively by relaying the data via satellite (such as GOES) from in situ data collection platforms (DCPs). Remote sensing from aircraft and satellite platforms using high data rate sensors (such as synthetic aperture radars) will likely become operationally routine by the mid to late 1980s.*

Large volumes of data, most of which needs to be culled, some of which is required in real time, certain portions of which should be archived, may be handled best by a central facility or data utility (the scheme proposed in the U.S. for earth resources satellite data). In any event, while the immediate

* C. E. Catoe, Low-Cost Information Distribution: New Directions for Technology Developments, Aeronautics and Astronautics, February, 1978.

future shows significant but not radical growth in ocean information needs, the government must look forward to the day when present system configurations may be inadequate to cope with the expected data explosion.

A further implication of growth is the need to add budget and man years to departments, or to improve present efficiencies through use of technology, if the requirements for services are to be met. The government's desire to limit the size of the public service leads to the conclusion that additional services will have to be supplied by the private sector. The AES, as an example, has recently moved to encourage private industry to carry out site-specific environmental forecasts for offshore oil and gas drilling operations. Where certain services have been provided traditionally by the government, the transition could be difficult and planning for such a shift should be started well in advance.

5.6 Recommendation

From the findings that:

- future needs could expand and intensify the requirements for ocean information, yet there are no regular means of assembling such needs on a government-wide basis,
- joint action will be imperative for planning certain ocean information systems,
- there is no easy mechanism for gathering together the funds needed for R and D on future data acquisition systems,
- there is a need for monitoring and auditing new technology being created elsewhere, and
- there is a need for establishing an effective method of interdepartmental funding and use of major capital facilities.

the study group on ocean information systems recommends that:

<u>a mechanism be established or identified to carry out on a continuing basis an integrated interdepartmental ocean information planning function, to</u>:

a) continually assemble and monitor user needs, and identify gaps that need to be filled, (federal, provincial and municipal governments and industry),

b) plan future ocean information systems in response to needs,

c) perform cost effectiveness studies on how new technologies can reduce costs and improve efficiencies in accomplishing current and future mandated management functions,

d) identify necessary R and D, and arrange for it to be done by government or industry using government technology agencies for advice and scientific program monitoring,

e) examine and take the necessary action to ensure needs are being met for technological requirements that tend to fall between mandates, such as communications and data transmission facilities,

f) monitor and audit foreign technology development programs,

g) identify long-range opportunities for the ocean information supply industry,

h) recommend suitable mechanisms for multi-departmental funding for major capital procurements,

i) establish and help to maintain standards for archival data collection, handling and storage, and

j) encourage the establishment of an ocean information referral service.

There are a number of organizational options through which such a program planning function might operate. They include:

- formation of an interdepartmental committee, tasked especially for the purpose, or
- designation of an existing department as having lead agency responsibility, or
- creation of an office, within a department, staffed interdepartmentally, or
- creation of an interdepartmental office reporting to the Panel on Ocean Management or comparable body.

It is beyond the terms of reference of the study group to go into details as to how such a function might be performed or the relative merits of having it attached to this department or that. The Steering Committee instructed the study group to identify what functions need to be performed, not how the functions could be carried out. The essential option is to determine whether the program planning functions listed above are conducted by separate departments as some are at present, or by all oceans-related departments together.

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4. Surveillance Satellite Project, Experimental Plan, Part 1, September, 1977.

5. C. E. Catoe, Low-Cost Information Distribution: New Directions for Technology Developments, Aeronautics and Astronautics, February, 1978.

A P P E N D I X   1

Ocean Information System Study: Steering Committee Members, Study Group Members, Study Group Briefings

Steering Committee, MOSST Ocean Information System Study

MOSST	- Mr. D.B. Dewar (Chairman) - Dr. D.I.R. Low
DFO/OAS	- Mr. G. Ewing
DOE/AES	- Dr. A.E. Collin
DND	- Mr. E.P. Black/Mr. J.F. Anderson
DOC	- Dr. J.H. Chapman
EMR	- Dr. P. Bourgault
DIAND	- Mr. E.M. Cotterill
DOT/CCG	- Mr. W.A. O'Neil

Members, Ocean Information System Study Group

Dr. P.A. Lapp - Chairman, retained under contract by MOSST

MOSST	- Dr. M.E. Smith - Mr. P. Beaulieu
DFO/FMS	- Dr. W.G. Doubleday - Mr. D. Rivard
DFO/OAS	- Dr. J.R. Wilson - Dr. R.A. Stacey (Panel on Ocean Management)
DOE/AES	- Mr. G. Morrissey - Mr. L.H. Ferguson - Mr. M. Thomas
DOE/EPS	- Mr. J.A. Karau
DOT/CCG	- Mr. J. Stewart - Mr. H. Whiteman
DND	- Capt. G.G. Armstrong - Lt. Cdr. J.H. Fyfe

EMR/CCRS	- Dr. L.W. Morley - Prof. D. Clough (SURSAT Program Office Representative)
EMR/RMCB	- Mr. P.E. Vandall, Jr.
DIAND	- Mr. G. Gainer - Dr. J. Keys
DOC	- Dr. O.S. Roscoe - Dr. A.L. Barry - Mr. E.A. Walker - Dr. R. Breithaupt
NRC	- Mr. L. G. Côté
ITC	- Mr. H. Shaver
PCO	- Mrs. K. Gourlie
Finance	- Mr. B. Backman-Beharry
TBS	- Mr. A. Lawless

<u>Other Study Group Participants</u>

MOSST	- Mr. T. Greenberg - Dr. L. Filotas - Mr. J. Coleman
DFO/FMS	- Mr. C.E. Button
DOE/AES	- Mr. G. McKay - Mr. F. Keyte - Mr. H.B. Kruger - Dr. J.D. McTaggart-Cowan
DOE/EPS	- Dr. J. Kingham - Mrs. B. Gervais - Mr. K.M. Meikle - Mr. F.O. Harnden - Dr. S. Ross

DOE/Office of Scientific Advisor

- Dr. J. Kruus

DOE/EMS	- Mr. T. Lash
DOT/CCG	- Mr. J. Howard - Mr. L. Landry
DND	- Capt. N. Lundhild - Cdr. R.J. Deluca - Mr. R.L. Jones - Maj. J.A. Faulkner - Cdr. R.F. Gladman - Col. B.R. Campbell
EMR/RMCB	- Mr. D. Sherwin - Mr. F. Lepine - Mr. G. Crockett - Mr. M. Bell
EMR/GSC	- Dr. B.R. Pelletier - Dr. A. Fricker
EMR/CCRS	- Mr. A.M. Kelly - Dr. A. McQuillan
EMR/Polar Continental Shelf	- Mr. G. Hobson
DIAND	- Dr. O. Loken - Mr. J.B. Kemper - Ms. M. Stawski - Dr. N.B. Snow
DOC	- Mr. W.D. Hindson - Mr. P.M. Boudreau - Mr. T. Eastland - Mr. D. O'Brien
NRC	- Dr. M. Collins - Mr. J.K. Pulfer

Working Group on Archival Information Systems

MOSST	- Dr. M.E. Smith (Chairman) - Mr. P. Beaulieu
DFO/OAS	- Dr. R. Stacey - Dr. J.R. Wilson

DFO/FMS - Mr. D. Rivard

DOT/CCG - Mr. H. Whiteman

DOE/EPS - Mr. J. Karau

EMR/RMCB - Mr. P. Vandall

DIAND - Dr. J. Keys

Briefings Received by Study Group

1. MUSAT - Mr. P.M. Boudreau, Mr. W.D. Hindson (DOC)
2. Videotex/Telidon - Mr. D. O'Brien (DOC)
3. Offshore Labrador Biological Studies - Mr. M. Bell (EMR/RMCB)
4. Eastern Arctic Marine Environmental Studies - Mr. M. Bell (EMR/RMCB)
5. Arctic Marine Oilspill Study - Dr. S. Ross (DOE/EPS)
6. Application and Enforcement of Part XX of the Canada Shipping Act in Fishing Zones 4 and 5 - Mr. H. Whiteman (DOT/CCG)
7. Maritime Contingencies Centre Study - Mr. H. Whiteman (DOT/CCG)
8. Regional Information Centre Concept - Dr. L.W. Morley (EMR/CCRS)
9. SEASAT Status Report - Mr. A.M. Kelly, Dr. A. McQuillan (EMR/CCRS)

Site Visits by Study Group

Ottawa
- AES Ice Central
- AES Ice Climatology and Applications Division
- DFO/OAS Marine Environmental Data Services Centre

Halifax

DOT
- ECAREG Centre
- VTM Radar Site
- Briefings on: ECAREG, VTM, ice operations and ice routing, pollution control, ship safety

DFO/FMS
- FLASH and Operations Coordination Centre

DND - MARCOM Operations Centre
- METOC Centre
- Rescue Coordination Centre
- Briefings on Maritime Command Operations, MCOIN II

DOE/AES - Maritimes Weather Office

Hermes Electronics Limited - Briefing on ocean data buoys

Other Meetings and Briefings

1. Discussions with AES officials, Toronto - Dr. P. Lapp, Dr. M. Smith, Mr. P. Beaulieu

2. Interdepartmental committee meeting on replacement systems for weatherships at Ocean Station Papa - Dr. P. Lapp, Dr. M. Smith

3. DND briefing of Surveillance Satellite Review Board on AWACS - Dr. M. Smith, Dr. R. Stacey

4. Meeting with Chairman, Panel on Ocean Management Multi-Tasking Sub-committee - Dr. P. Lapp, Dr. M. Smith

5. Individual meetings with following ADM's:

   Mr. D.B. Dewar (MOSST), Mr. G. Ewing (DFO/OAS) - Dr. P. Lapp
   Dr. M. Smith

   Dr. A.E. Collin - Dr. P. Lapp

APPENDIX 2

Surveillance Requirements

Information Systems - Real Time

Information Systems - Archival

CONTENTS

INTRODUCTION

The Panel on Ocean Management specified that the present study review departments' present and anticipated ocean data/information needs and also survey present and envisaged ocean data acquisition and handling systems. In addition, the Surveillance Satellite Review Board has requested a survey of future ocean surveillance requirements and a summary of existing ocean surveillance systems.

This Appendix outlines the surveillance data requirements of departments having ocean management responsibilities and describes the systems which have been established to handle surveillance data and other types of ocean management data/information. The material in the Appendix is organized according to ocean management function and is further sub-divided under the following headings:

I SURVEILLANCE REQUIREMENTS: - A detailed survey of departments' ocean surveillance requirements for the period 1980-2000 was carried out by the Surveillance Satellite Task Force in 1976 and published in the report Satellites and Sovereignty. These findings were used as the basis for the present survey in that members of the Ocean Information System Study Group were asked to review statements of requirements given in Satellites and Sovereignty, and to determine whether these still represent departments' envisaged ocean surveillance needs.

Departments' responses are described in the following pages. All of the categories used in Satellites and Sovereignty to characterize the surveillance requirements have been retained; however, in recognition of the broader terms of reference of the current study, additional material has been included on: geographical areas of interest, surveillance data acquisition and surveillance data handling and processing. Further, assessments of the capabilities of current surveillance systems is given under the heading "Present Situation", wherever possible.

One of the surveillance applications described in Satellites and Sovereignty, i.e. cartography, has been expanded considerably in this report to include hydrography, oceanographic surveys and marine geoscience surveys. This reflects the fact that the concerns of the current study are somewhat wider than satellite applications of remote sensing.

Two of the surveillance applications, i.e. forest resource management (in areas under DIAND jurisdiction) and flood control, are not directly related to ocean management. Updates on these applications are included here, however, so that the present study can be considered as a complete revision of the Surveillance Satellite Task Force survey.

With respect to the surveillance data specifications (accuracy, frequency of observation, response time), departments have indicated that there have been very few changes in the requirements as stated in Satellites and Sovereignty. Where there have been changes, specific mention of the original requirement is given in italics.

It is important to note that the original survey was of surveillance needs for the period 1980-2000. *The present survey reassesses these requirements for 1980-2000, and is therefore an updated statement of future surveillance needs*.

II INFORMATION SYSTEMS - REAL TIME: - The Progress Report on this study prepared in July, 1978, contained as an appendix an inventory of existing information systems, described according to: purpose; users; data acquisition; data handling, processing and retrieval; remarks on anticipated system development and anticipated system requirements. The present Appendix contains these earlier inventory descriptions for the major real time on-line systems only. In some cases, the system descriptions have been altered to reflect updated information and to reduce duplication of material already covered in the section on SURVEILLANCE REQUIREMENTS.

III INFORMATION SYSTEMS - ARCHIVAL: - Departments maintain many archival systems or data banks in support of their ocean management activities. Such systems are described briefly in this section of the Appendix. Included here are brief descriptions of several archival systems which had been portrayed in much greater detail in the system inventory of the July, 1978, Progress Report.

Management of Renewable Resources

OCEAN MANAGEMENT FUNCTION: Management of renewable resources

I SURVEILLANCE REQUIREMENTS

APPLICATION: Fisheries surveillance

DEPARTMENTS: DFO (lead agency), DOT and DND (surveillance activities)

SURVEILLANCE INFORMATION REQUIRED:

- Location and identification of foreign and domestic fishing vessels, (includes vessel movements, entry and exit from Canadian zones)
- Fishing activities (includes gear being used, fish catches, transfer of fish between vessels, quota adherence)

SURVEILLANCE TARGETS:

- Single ships inside the 200-mile zone, as well as on known fishing grounds outside the 200-mile zone. Ships range in size from 10 metres to 30-50 metres.
- For identification purposes, need to read letters and numbers 1 metre in length painted on ship sides.

(Original requirement to Task Force: clusters of ships, ranging in size from 10 m up to 30-50 m, concentrated on known fishing grounds)

SURVEILLANCE INFORMATION SPECIFICATIONS:

1. GEOGRAPHICAL AREAS OF INTEREST:

Present: -Attached maps (prepared for DOT inter-departmental study of vessel source pollution) show distribution of foreign and domestic fishing vessels on Atlantic coast during summer and winter months, and distribution of domestic vessels and selected foreign catches for Pacific coast. (1977)

-Obvious priority areas: Scotian Shelf and Flemish Cap on Atlantic coast, entire 20-40 mile width of Pacific Continental Shelf.

-Some fishing activity in Davis Strait, shrimp being exploited in Baffin Bay.

-Foreign fishing effort has increased in Atlantic coastal areas outside the 200-mile zone (Flemish Cap and Tail of the Banks); stock management in these areas is under international control, but increased Canadian surveillance effort is required.

Future: - Foreign fishing effort is expected to remain fairly constant over the next 3-5 years. Domestic fishing of "non-traditional" species and in ice-covered waters areas should increase.

-Canadian control may be extended to include Flemish Cap and Tail of the Banks.

2. ACCURACY:

Requirements:

- Location of individual ships to 2-4 km
- *(Original requirement to Task Force: location of centroid of fleet to 2-4 km.)*

Presently Obtained:

- ½ to 5 km, depending on systems used.

3. FREQUENCY OF OBSERVATION:

Requirements:

- Daily or more frequently, depending on cost-benefit analysis.

Presently Obtained:

- Current requirement is to locate and identify each fishing vessel operating within Canadian jurisdiction at least once a week, to board one-sixth of Canadian fleet and one-third of foreign vessels every month.
- Fisheries observers on selected vessels report on catches and activities.

- Although surveillance is seasonal for specific fisheries, overall monthly surveillance program is relatively constant

4. RESPONSE TIME:

Requirements:

- 4-6 hours

Presently Obtained:

- DND information could be provided within 4 hours of sighting of individual targets; however, cumulative surveillance results are usually provided to DFO within 24-30 hours.

SURVEILLANCE DATA ACQUISITION:

Present:

- Surveillance requirements are determined by regional interdepartmental committees, chaired by DFO, with DND and MOT representation.

- Fisheries surveillance by:

1. Vessel:

	Sea-Days	
	Atlantic (Jan.-June 1978)	Pacific (1977-78)
DFO	462	285
DOT	41	-
DND	137	135

2. Aircraft:

- 1978 Tracker hrs.

	Atlantic	Pacific
dedicated	3222	837
multi-tasked	1033	-

- additional coverage by DFO chartered aircraft and DND Argus patrols

3. Observers placed on foreign vessels to monitor catch and activities and to collect biological samples.

4. Boardings by fisheries inspection officers from DFO, DND, and DOT vessels.

- DFO considers that the present surveillance program, especially for the foreign fleet, is functioning effectively; however, recent budget cutbacks could pose problems.

Possible Future Developments:

- DND and DOT may reduce assistance levels.

- DND and NRC investigating possible extension of Tracker lifetime beyond 1985.

- DFO is investigating use of airships for surveillance.

- Other technological developments of interest to DFO: improved communications with patrol vessels, radar imagery from satellites, use of "black boxes" for positioning.

- Surveillance requirements may be reduced (especially in distant areas or areas of frequent bad weather) by the placing of more observers on both domestic and foreign vessels.

- Areas of interest are often fog-covered, with visibility of less than 30 m, 5 days out of 7. Daily or more frequent all-weather radar imagery would provide useful strategic pictures of fishing fleet deployment.

SURVEILLANCE DATA HANDLING/PROCESSING:

- Fisheries surveillance information (including dedicated DND surveillance results) is incorporated into the FLASH system (see following description).

- Relevant information from classified DND systems is made available to DFO personnel with appropriate security clearance and need to know.

- There are currently no plans to directly link DND and DOT systems to FLASH. However, DND's M-COIN II, which is expected to be operational in 1982, could, with appropriate security filters, be linked to FLASH.

- Improvements are required for handling of surveillance data on domestic fishing vessels. FLASH is not used for storing or retrieving data on domestic vessels. DND's MARCOM computer is used for information on sightings of both foreign and domestic vessels, but retrieval criteria do not completely coincide with DFO requirements for domestic vessels.

Each plain circle is one vessel sighting (1977)
Shaded circles represent several overlapping sightings

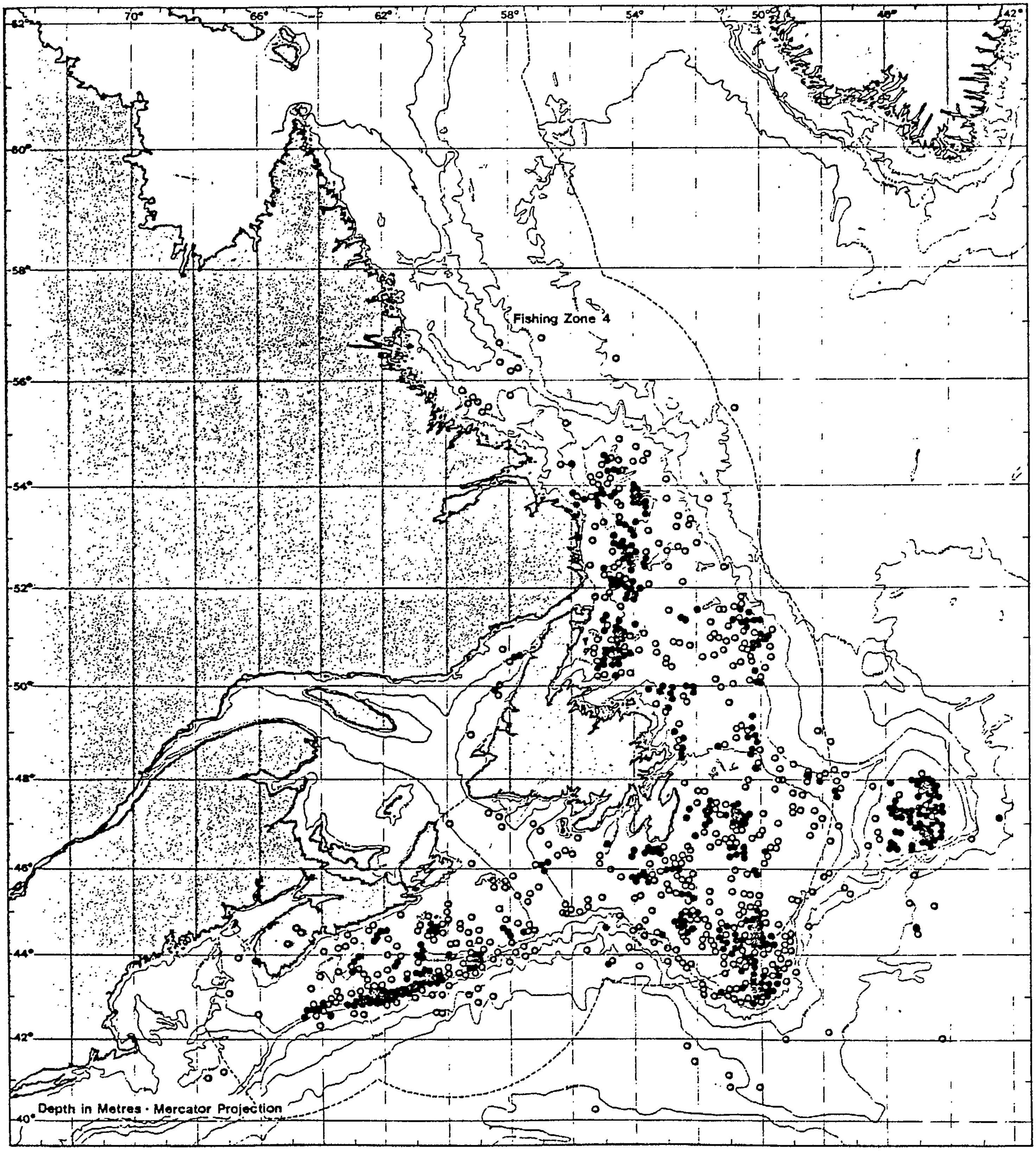
Vessel Source Pollution in Canadian Fishing Zone 4

Foreign Fishing Vessels: Summer

Distribution
Total Number of Vessels=3705

Canadian Coast Guard
Fisheries and Marine Service

James Dobbin Associates
Coastal & Marine Resource Planners



Each plain circle is one vessel sighting (1977)
Shaded circles represent several overlapping sightings

Vessel Source Pollution in Canadian Fishing Zone 4

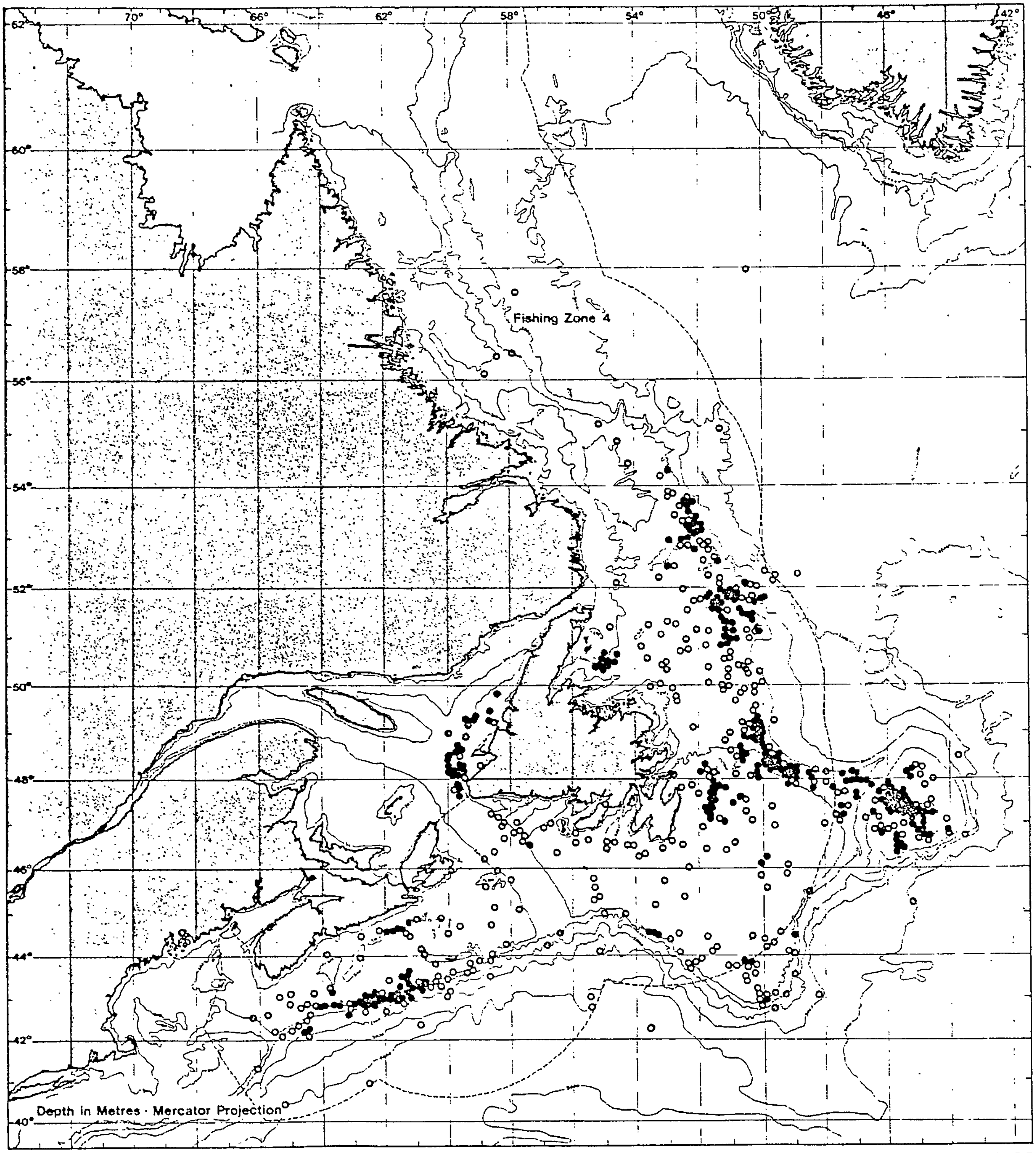
Foreign Fishing Vessels: Winter

Distribution

Total Number of Vessels=2373

Canadian Coast Guard
Fisheries and Marine Service

James Dobbin Associates
Coastal & Marine Resource Planners



Each plain circle is one vessel sighting (1977)
Shaded circles represent several overlapping sightings

Distribution

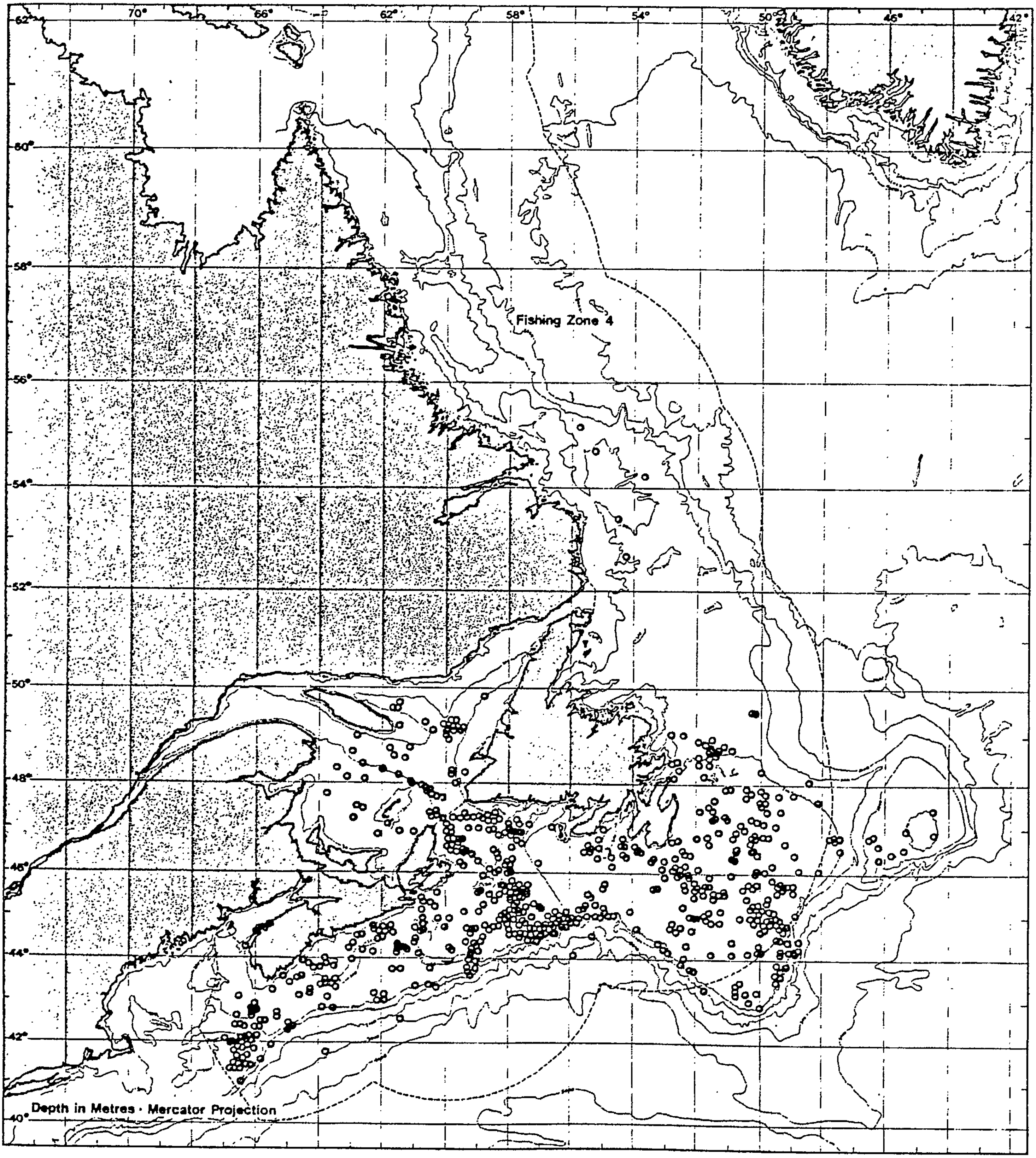
Total Number of Vessels=1218

Vessel Source Pollution in Canadian Fishing Zone 4

Domestic Fishing Vessels: Summer

Canadian Coast Guard
Fisheries and Marine Service

James Dobbin Associates
Coastal & Marine Resource Planners



2-14

Vessel Source Pollution in Canadian Fishing Zone 4

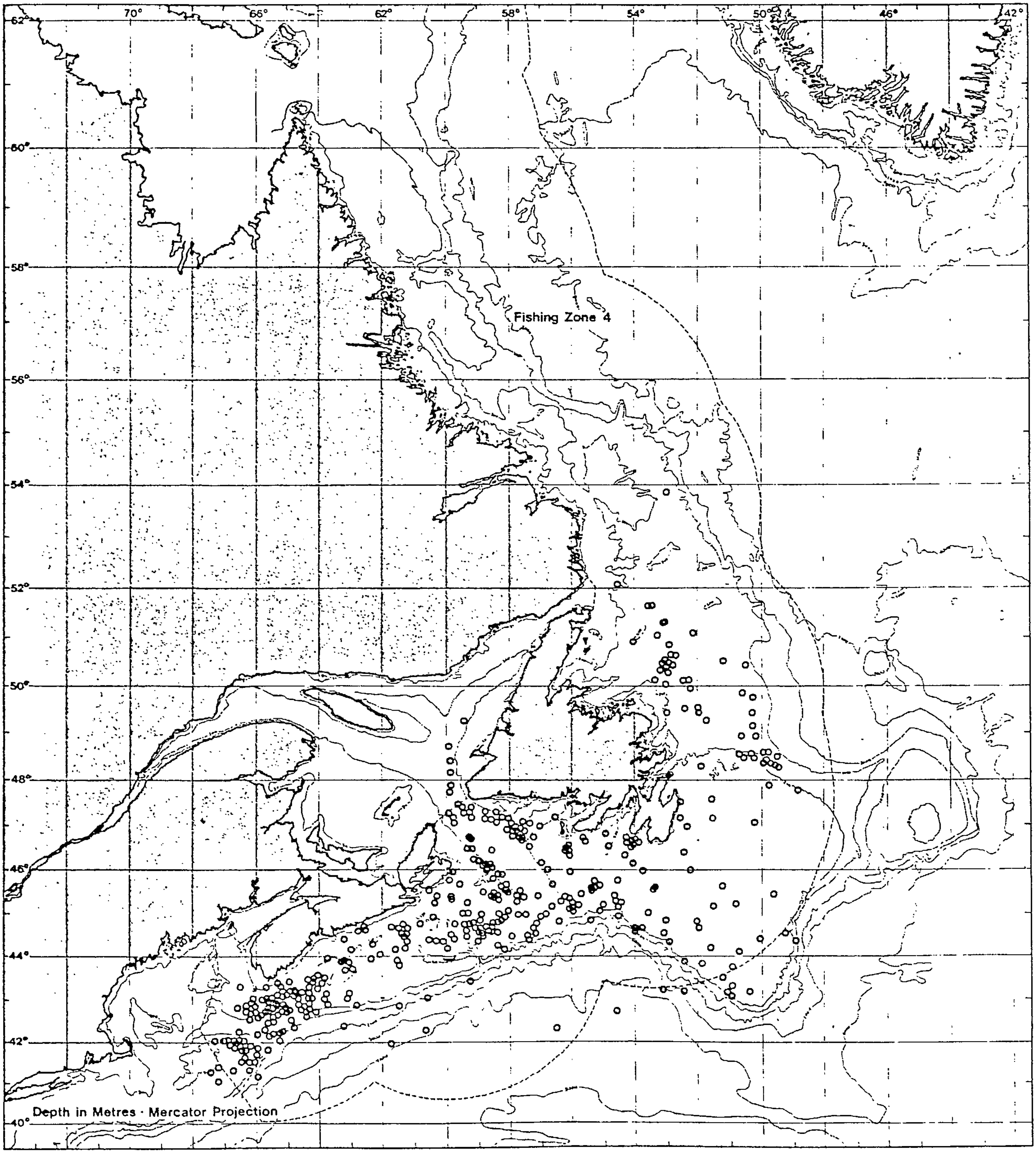
Domestic Fishing Vessels: Winter

Each plain circle is one vessel sighting (1977)
Shaded circles represent several overlapping sightings

Distribution
Total Number of Vessels = 870

Canadian Coast Guard
Fisheries and Marine Service

James Dobbin Associates
Coastal & Marine Resource Planners



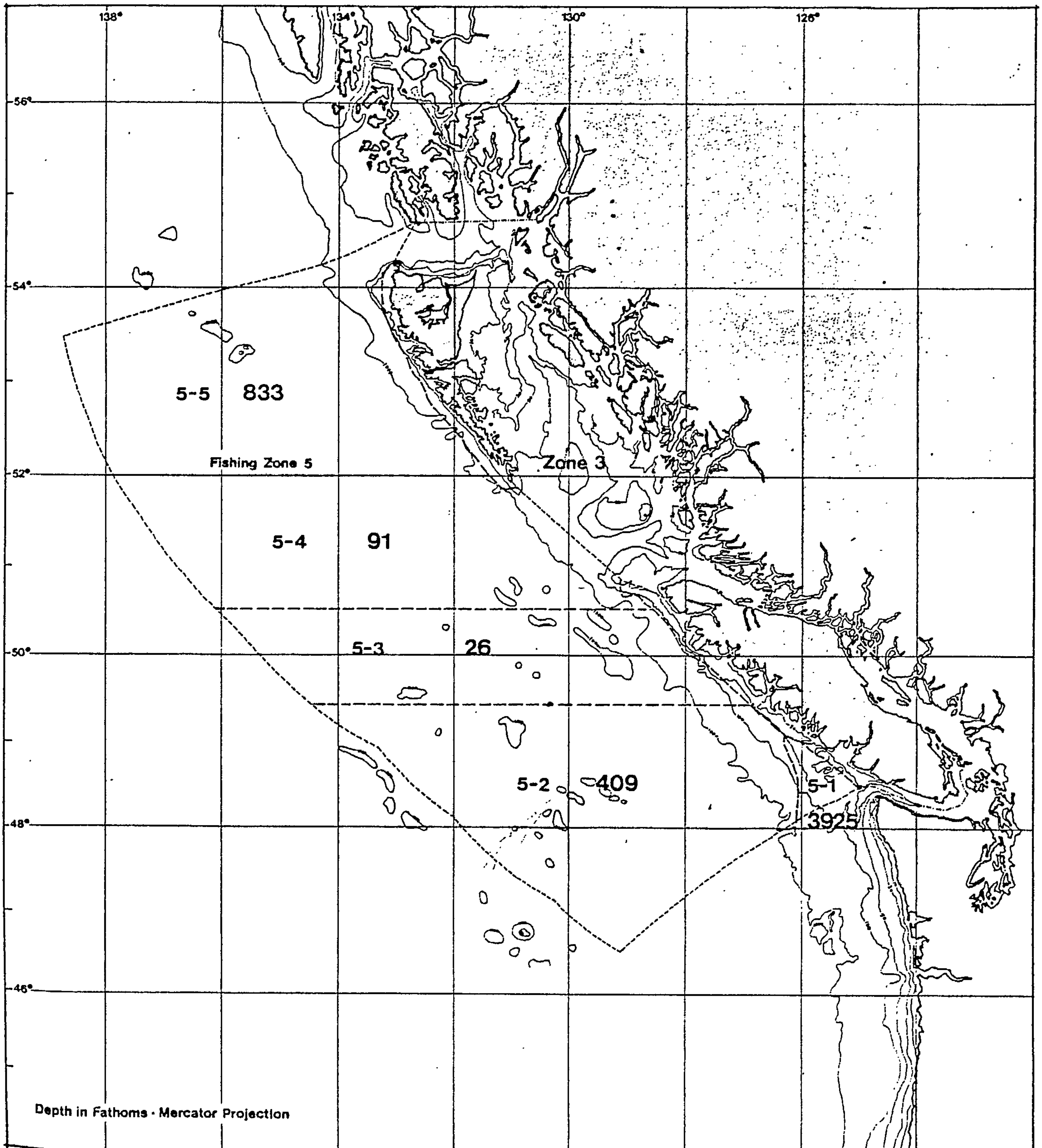
Vessel Source Pollution in Canadian Fishing Zone 5

Fishing Vessel Distribution: Domestic

5-1 Sub-Zone
3925 Number of Vessels

Canadian Coast Guard
Fisheries and Marine Service

James Dobbin Associates
Coastal & Marine Resource Planners



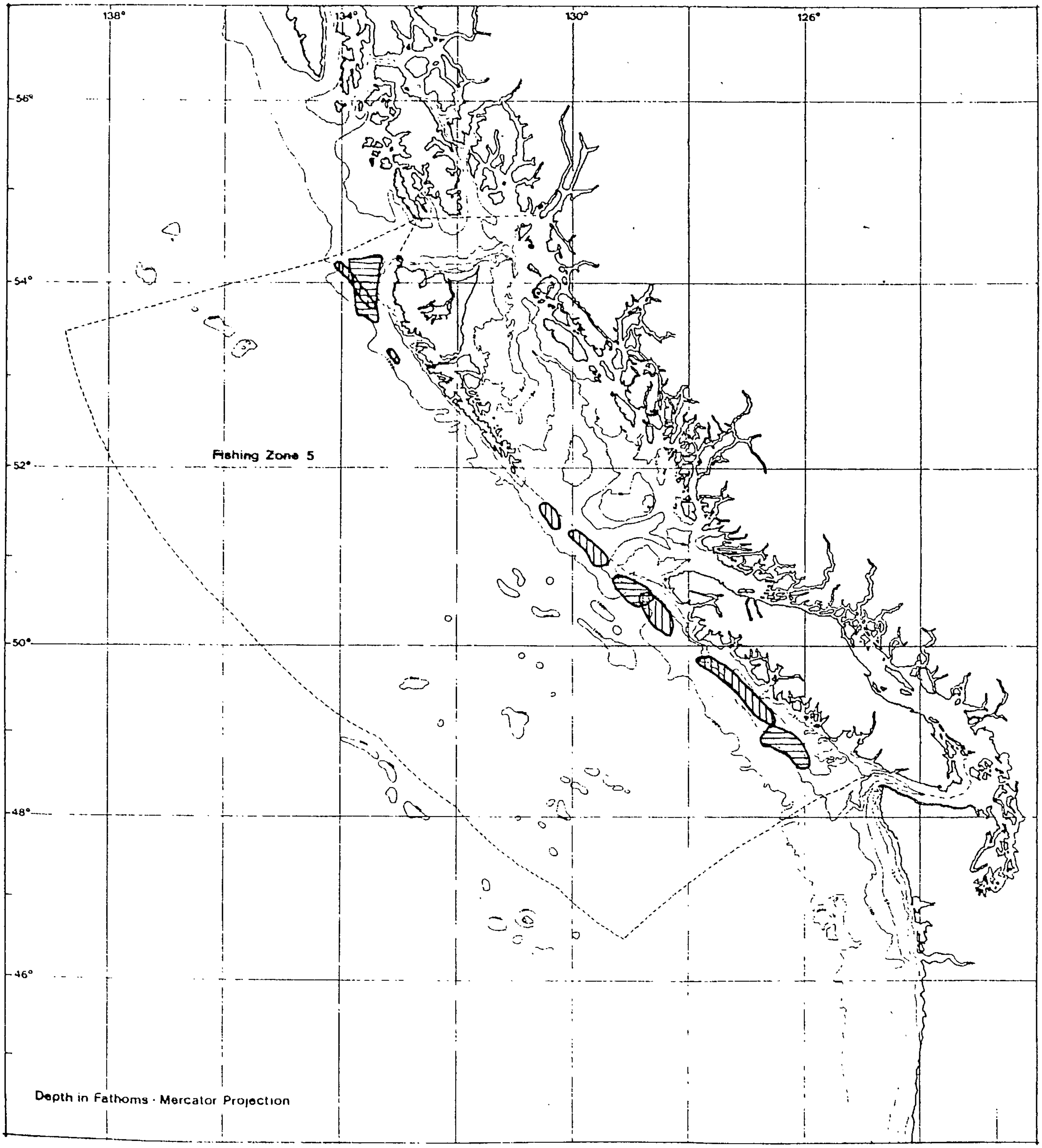
Vessel Source Pollution in Canadian Fishing Zone 5

Foreign Catch, 1977: Hake, Rockfish, & Sablefish

Hake, Rockfish
Sablefish

Canadian Coast Guard
Fisheries and Marine Service

James Dobbin Associates
Coastal & Marine Resource Planners



II INFORMATION SYSTEMS - REAL TIME

Function: Renewable Resource Management

Basis in Law: Fisheries Act, Territorial Sea and Fishing Zones Act.

Department: DFO/FMS, (Fisheries Management Program)

System

FLASH - Foreign Licencing and Surveillance Hierarchical Information System

Purposes:

- to fulfill information needs for licence, surveillance and quota management operations for foreign fishing activities in Canada's 200 mile zone of fisheries jurisdiction (domestic fishing activities not included).
- to respond to requests for information for scientific purposes.
- to monitor and support performance of patrol vessel and aircraft operations.

Users:

- main users: DFO regional personnel across country involved in daily operations of management of fishing jurisdiction; FMS headquarters in Ottawa.

Data Acquisition:

- most data on a daily or weekly turnover basis in various forms
- data collected from: foreign countries; by radio from foreign vessels and DFO observers on foreign vessels; surveillance reports from DFO, DND, DOT ships and aircraft; boarding reports from fisheries inspection officers.

Data Handling, Processing and Retrieval:

- system accessed many times daily
- data sent to intelligent computer remote terminals at St. John's, Halifax, Vancouver and Ottawa.
- regional FLASH managers are responsible for data entry into these remote terminals
- data is edited at point of entry, classified in terms of Keys for Searching and updated daily.
- software structure: System 2000 natural language
- data quality is maintained by performance standards, controls on timeliness, completion and accuracy; quality of service is monitored by formal feedback mechanism
- data forms entered interactively onto magnetic tapes for transmission to main FLASH database resident on EMR's CYBER computer in Ottawa
- the Ottawa centre updates and maintains system and supervises regional personnel
- information outputs available upon request on a dialup basis every day.

Parameters

Inputs:

- archival and real time data on foreign fishing and sealing vessels in 200 mile limit (500 off East Coast and a few dozen off West Coast)

Data Inputs	Sources
Vessel Specifications and Data Sheet	Foreign
Licence Application	DFO
Sighting Form	DFO, DND, DOT
Boarding Form	DFO, DND, DOT
Catch and Effort Reports	Foreign fishing vessels
Vessel Entry into Canadian Waters Report	Foreign fishing vessels
Vessel Departure from Canadian Waters Report	Foreign fishing vessels
Port Entry Reports	DFO regional officers
Port Departure Reports	DFO
National Catch and Effort Quotas	Resource allocation Personnel
Closed Fisheries	DFO
Modifications	Regional personnel
Change National Allocation	Resource allocation Personnel in regions or Ottawa

Outputs:

- daily updates on foreign fishing information.
- daily exception reports that point out discrepancies and violations.
- major reports: Key Fields, Terminal Reports, Bulk Reports, and Plots--in FORTRAN procedural language.

Remarks

- the FLASH system started in January, 1977
- regional managers need better tools for data quality monitoring and control; intelligent data entry terminals are being introduced to improve timeliness and to reduce costs by avoiding inefficient use of the CYBER mainframe in Ottawa.
- consideration now being given to include domestic fishing activities.

III INFORMATION SYSTEMS - ARCHIVAL

Fisheries management archival systems and data banks maintained by DFO include:

(1) FEDS (Fisheries Experimental Database System) - FEDS was established in 1977 to make available, at one location and in a standardized readable format, most of the data concerning the operation of the Canadian saltwater fishing industry. The system combines, rearranges into a common format, and groups into two databases (east coast, west coast) information from regional computer data banks on vessel registration and licensing of fishermen, commercial fish landings and effort statistics.

(2) Registration of fishing vessels and licensing of fishermen - This data bank is used for administering registration and licensing programs in the regions. Input include vessel identification and other characteristics and relevant information on the fishing activities of fishermen. Outputs include reports on licences and vessel registration.

(3) Commercial catch and effort statistics - This data bank, used for monitoring and analyzing fishing activity, keeps track of details of fish landings, effort, and fishing activity, by community and by month. Sources of data include fish buyers' receipts of purchase, vessel log records and other pertinent material from DFO field officers.

(4) Various data banks are maintained for scientific research on stock assessments and population dynamics. These include:

(a) data collected on research cruises for groundfish inventory and plankton density;

(b) data from samples of the commercial catch as it is landed;

(c) data from observers on foreign ships and from foreign fishing logs;

(d) data from fish tag returns.

From these data banks are derived abundance estimates, length frequencies and age-length keys for selected species, catch composition and catch rates of the foreign fleet, tables and plots of plankton distribution and density.

(5) Analyses of frozen fish stocks held by processing plants.

(6) Vessels and fish plant inspection data.

Management of Non-Renewable Resources

OCEAN MANAGEMENT FUNCTION: Management of non-renewable resources

APPLICATION: Surveillance aspects of offshore non-renewable resource management

I SURVEILLANCE REQUIREMENTS

DEPARTMENTS: EMR, DIAND. DND conducts surveillance activities

SURVEILLANCE INFORMATION REQUIRED:

- Disposition, identification and activity of all drilling platforms, work boats, drilling ships, seismic survey vessels and other research or survey ships.

SURVEILLANCE TARGETS:

- Need location, identification, course and speed of all targets, as well as estimate of activity. Drilling platforms are large (100 m + on a side), usually triangular platforms; drilling ships are 100 m long or larger; both have unique super-structures. Other craft often have unique super-structure features; sizes range from 30 m - 150 m. Speeds range from 0 to 15 knots.

- Most targets will be cooperative and would carry appropriate devices for identification if desired. Their characteristics are such that detection and classification should not present a problem for drilling platforms and ships (e.g. large angle-iron drilling towers). Speeds will usually be slow for working survey vessels or platforms under tow.

- Underwater targets are not currently of concern.

SURVEILLANCE INFORMATION SPECIFICATIONS:

1. GEOGRAPHICAL AREAS OF INTEREST:

   - Sea waters inside edge of continental margin north of 60°N (DIAND) and between 40° and 60° off east coast, between 49°N and 60°N off west coast, together with all of Hudson Bay (EMR). See attached map.

GEOGRAPHICAL AREAS OF INTEREST (continued):

- Hydrocarbons:

  - EMR: Exploration is presently confined to the East Coast with activity centred on the Labrador Shelf and Northwest Newfoundland Shelf. 1979 will see the first activity on the continental rise off the Flemish Cap with two wells being proposed. If exploration does not indicate more encouraging results in 1979, drilling activity on the East Coast could diminish somewhat. If commercial reservoirs are found and developed, production itself would take up to a decade from the time of discovery.

    EMR: Exploration activity on the West Coast may recommence in a year or two.

  - DIAND: Exploration and development activities between now and the mid-1980's are expected in the Beaufort Sea, Lancaster Sound and Baffin Bay.

  - Canadian Petroleum Association: Given favourable conditions (tax rates, prices, etc.), the following offshore exploration activities could be expected:

Beaufort Sea	1979-82	average of 4 drillships operating per year
	1982-99	average of 6 drillships operating per year, assuming earlier success
Labrador and Eastern Arctic	1979-85	average of 5 drillships operating per year
	1985-90	average of 8 drillships operating per year, assuming earlier success
East Coast	1979-85	average of 1 drillship operating per year

  - Commercial scale production is expected to begin in 1983 with the Arctic Pilot Project bringing LNG by tanker from Melville Island to southern markets. The most likely area for offshore production activities is the Beaufort Sea where Dome has estimated that oil production could begin by 1985.

- Other Minerals:

  - EMR: There is presently some exploration for coal reserves off Cape Breton, N.S. The development of these reserves, however, would probably be from land. There is some promise for hard minerals such as placer gold, magnetite, titanium minerals and sand and gravel, but due to onshore abundance, interest in these is generally considered minimal.

  - DIAND: No offshore mineral exploration is anticipated for at least the next 15 years.

2. ACCURACY:

   Requirements:

   - Locations needed to 50 metres for drilling sites; these may be with reference to known landmarks. However, following the final legal survey, location of oil rigs is known to ± 2 m.

   - For survey vessels performing a survey, position is needed to 100 m. For vessels/platforms in transit, 2-4 km is adequate.

   - No changes in requirements are expected for at least the next 10 years.

   Present Situation:

   - Above accuracies are currently obtained.

3. FREQUENCY OF OBSERVATION:

   Requirements:

   - Maximum frequency of 4 observations per day, but once daily is acceptable.

   Present Situation:

   - DIAND: Once every 2 weeks, by DND Argus flights.

   - EMR: DND overflights at 5-day intervals from May through October in specific areas; other areas covered at 1-month intervals.

- Frequent on-site inspections are made by government personnel. The purpose of this requirement, *according to the Task Force report*, is to provide more frequent information of a strategic nature on the deployment and activities of resource exploration/exploitation vessels, as well as to detect unauthorized activities or vessels. *(However, EMR indicates that these inspections are primarily for safety and pollution control purposes, and not for strategic purposes.)* EMR is planning to increase frequency of on-board inspections.

4. RESPONSE TIME:

Requirement:

- 6 to 12 hours

Present Situation:

- Typically 6 to 18 hours after observation.

SURVEILLANCE DATA ACQUISITION:

Present:

- DND has formal arrangements with EMR and DIAND to provide aerial surveillance by Argus patrol aircraft. Agreement would also include provision of submersibles for inspection of pipelines and other seafloor installations where necessary.

- Monitoring by the regulatory agencies consists of:

  (1) Routine daily, weekly and complete reports from the operator. Reports are made daily in the case of drilling operations. Reports include meteorological and oceanographic information.

  (2) Periodic inspections of drilling units and survey ships.

(3) Review of all information (including regional information on weather, sea state, currents, and ice conditions) submitted by an operator in the application for approval of an exploratory program. At the completion of the program, summary reports are filed with the regulatory agencies.

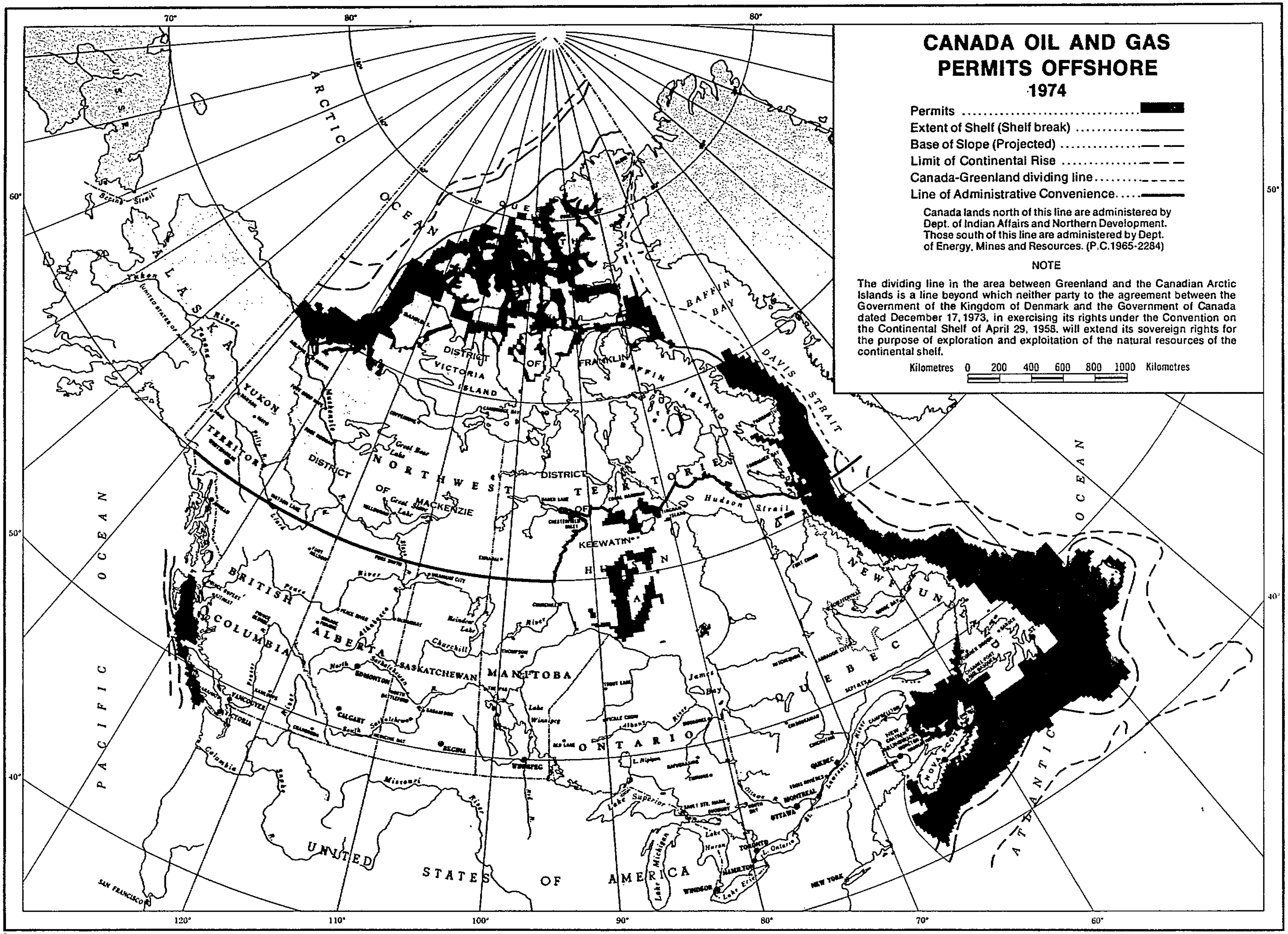
Possible Future Developments:

- Replacement of DND Argus aircraft by the Aurora.

SURVEILLANCE DATA HANDLING/PROCESSING:

- All DND surveillance results reported to DND Command headquarters. Relevant information made available to EMR, DIAND in formatted messages. (See description of defence data acquisition and processing system elsewhere in this report.
- Working locations of some survey vessels may be classified information.

- Reports from operators (including geological, geophysical, and drilling results) are archived by EMR and DIAND. EMR material retained in paper files; DIAND material on paper files and computerized data banks.



Produced by the Surveys and Mapping Branch, Department of Energy, Mines and Resources.

II INFORMATION SYSTEMS - REAL TIME

The government has no major real time on line information systems associated with non-renewable resource management. DND surveillance activities in support of non-renewable resource management are included in the description of the DND system to be found elsewhere in this report.

III INFORMATION SYSTEMS - ARCHIVAL

(1) Hydrocarbons - DIAND (Drilling Authority Files and Notices of Commencement of Exploratory Work): The Northern Non-Renewable Resources Branch of DIAND maintains a combined computerized and paper file archive of information which is used by the department for the assessment and approval of industry exploration programs before they begin, and for the supervision and regulation of field operations. Information is submitted by operators in order to obtain program approval, on a daily and weekly basis during the program and on a summary basis on program completion. Information includes statistics, expenditures, technical data (including geophysical, geological and drilling data) and environmental information (weather, sea state, ice conditions, etc.). DIAND is the primary user of the system with accessing occurring several times daily through remote terminals. Other government departments, industry and the general public also have access to the archived information although this is governed by varying periods of confidentiality.

(2) Hydrocarbons - EMR: The Resource Management and Conservation Branch of EMR maintains a paper file archive which, like the above DIAND data bank, is used for the assessment and approval of industry exploration programs before they begin and for the supervision and regulation of field operations. Information acquisition procedures and the types of information archived are similar to the DIAND system.

(3) Offshore minerals other than hydrocarbons - EMR: EMR has established a combined computerized and paper file information system on offshore non-hydrocarbon mineral resources. The purposes of this archival system are: to provide information for the assessment, regulation and management of offshore mineral resources other than petroleum that occur within Canadian jurisdiction, and to provide information for use in the formulation of Canadian policy

with respect to seabed mineral resources outside Canadian jurisdiction. Data acquisition is through routine monitoring of journals, magazines and other material, and through departmental contacts with personnel in industry and other governments. The system is managed by EMR's Departmental Coordinating Committee on Ocean Mining. Conventional files are maintained by CANMET (technological information), Geological Survey of Canada (geological information), Resource Management and Conservation Branch (RMCB) (corporate information) and Mineral Policy Sector (economic information). Computerized bibliographic citation storage and retrieval systems are maintained by CANMET and RMCB.

OCEAN MANAGEMENT FUNCTION: Non-renewable resource management

APPLICATION: Arctic sovereignty aspects of non-renewable resource management

I SURVEILLANCE REQUIREMENTS

DEPARTMENTS: DIAND (responsible for Arctic non-renewable resource management), DND (carries out surveillance)

SURVEILLANCE INFORMATION REQUIRED:

- Location, size, identification and description of seismic lines cut on land, exploration or survey parties on land or ice, lodgements and base camps on land or ice, drift stations on ice islands.

- Includes position and size of area concerned; identification of structures, equipment, aircraft and vehicles; estimate of activities of hydrocarbon and mineral exploration parties.

SURVEILLANCE TARGETS:

- Seismic lines are clearings through trees or brush, up to 10 m wide by several km long. During survey work, there will be men and machinery in the cuts. Seismic crews on ice consist of about 15 vehicles spread out in a column. Other targets consist of clearings in treed or brush-covered areas or on snow or ice, new roads or trails in unpopulated areas, clusters of small buildings or tents, trails, vehicles and equipment, aircraft and aircraft runways.

- Machinery and vehicles used by seismic crews are bulldozers, metal trailers with large rectangular bodies, trucks with cylindrical tanks 3 m dia. x 5 m long. Vehicle sizes range from 3x4 m to 5x15 m, usually strung out in columnar formation. Targets for other requirements are stated, with sizes from one metre up to some tens of metres for large aircraft. A wide range of metallic and non-metallic materials is employed.

- The targets of prime interest are small groups of men working at or near small, often rudimentary camps. They will have a variety of shelters, vehicles (often including aircraft, both rotary and fixed wing), communication facilities and other equipment.

- Possible underwater activities would presumably be directed from a mother ship which would be the primary surveillance target.

SURVEILLANCE INFORMATION SPECIFICATIONS:

1. GEOGRAPHICAL AREAS OF INTEREST:

   - Yukon and Northwest Territories, all Canadian areas north of 60°N.

   - Requirements differ with seasons. Marine areas are generally inactive during winter. Surveillance activities are shifted south near 60°N from November to February to make best use of daylight.

2. ACCURACY:

   Requirements:

   - Locations required to 100 metres for survey crews; for military requirements 2-4 km is adequate.

   - Temperatures to 2°C for detection; 0.25°C for identification.

   Presently Obtained:

   - N.A.

3. FREQUENCY OF OBSERVATION:

   Requirements:

   - Generally, daily.

   - Twice per day for marine seismic operations decreasing to once a week in winter.

Presently Obtained:

- DIAND: not carried out presently

- DND: monthly to semi-annually

4. RESPONSE TIME:

Requirements:

- 12 hours

Presently Obtained:

- DIAND: not applicable because of present lack of surveillance activities

- DND: typically 12 hours after observation

SURVEILLANCE DATA ACQUISITION

- Routine DND air surveillance patrols, primarily by Argus aircraft. See description of DND data acquisition and handling systems.

SURVEILLANCE DATA HANDLING/PROCESSING:

- See description of DND data acquisition and handling system.

- Data format: video tape, photographic imagery, maps, telex.

- Targets of particular military interest may require security classification.

- Relevant surveillance information is passed on by DND to DIAND and other departments.

COMMENTS:

- Legitimate resource exploration parties are expected to be co-operative and, if requested, would carry electronic or other identification devices. Drift stations on ice islands, set up for scientific purposes, tend to be of a more substantial nature and operate for months at a time.

- It is desirable also to check for pollution, ecological damage and/or excessive erosion caused by these activities.

- DIAND: "Non-legitimate" activity has been reported several times per season, and suspicions are that more of this type of exploration is carried out without government knowledge.

Protection of the Marine Environment

OCEAN MANAGEMENT FUNCTION: Protection of the marine environment

I SURVEILLANCE REQUIREMENTS

APPLICATION: Surveillance of marine pollution

DEPARTMENTS: DOE, DFO, DOT, DND, DIAND, EMR

SURVEILLANCE INFORMATION REQUIREMENTS:

- Type, location, rate and direction of drift, source, quantity of ocean pollution.
- Detailed identification of polluter and pollutant required for prosecution.

SURVEILLANCE TARGETS:

- Oil slicks, turbidity variations or water discolouration of approximately 200 m. diameter or larger.
- Principal ship-borne pollutant is petroleum hydrocarbons; others are metals, halogenated hydrocarbons, floating solid wastes, radionuclides. Drilling mud is also a concern.
- Ship source pollution can be "operational" (arising from normal shipboard operations such as bilge pumping and tank cleaning) or can arise through accidents such as sinkings, collisions, etc. Accidental discharges are much less frequent than operational ship source pollution but can be such as to cause significant pollution risks (e.g. Torrey Canyon).
- Other sources of marine pollution: offshore oil well blow-outs, ocean dumping (primarily of dredged material), land-based sources.
- Detection requirement for oil: 15 ppm.
- Pollutants other than oil less easily susceptible to remote sensing surveillance.

SURVEILLANCE INFORMATION SPECIFICATIONS:

1. GEOGRAPHICAL AREAS OF INTEREST:

Present:

- Generally, to the 200 mile limit on both east and west coasts and within the 100 mile zone established under the Arctic Pollution Prevention Regulations.
- Areas of particular concern: major fishing grounds, areas of heavy vessel traffic, offshore drilling sites (especially in Beaufort Sea and Labrador Sea), Arctic waters (oil pollution), ocean dumping sites.
- Canada claims and exercises sovereign rights to mineral resources of the continental shelf to the outer limits of her submerged continental margin. This jurisdiction provides for Canadian control of offshore mineral and hydrocarbon exploration and any pollution that may be related to it in many areas that are beyond the 200 mile limit.

Future:

- Increased concern will concentrate on new or expanded areas of offshore drilling such as the Eastern Arctic where exploratory drilling will begin in 1979.
- Eventual offshore hydrocarbon production activities would significantly increase pollution surveillance requirements in the areas concerned.

2. ACCURACY:

Requirements:

- Location of centroid of pollution to about 1 km.
- DIAND: Positional accuracy: ± 500 m; resolution of aerial coverage to 200 m x 300 m.

Present Situation:

- DIAND: The above accuracies are obtained

- DOT and DOE: "Whatever we can obtain with current technology."

3. FREQUENCY OF OBSERVATION:

Requirements:

- For detection - daily

- For tracking - continuous

Present Situation:

- DIAND: drilling operations monitored on a 24-hour basis

- EMR: periodic inspection by RMCB personnel; DND overflights at 5-day intervals from May through October in specific areas, with other areas covered at one-month intervals.

- DND: over 5000 hours per year coastal and offshore surveillance patrols multi-tasked to include pollution surveillance (includes chemical pollution from shore facilities).

- DOT: as available by overflight call-up of satellite observation; present frequency - nil

- DOE: relies on DND overflights at 4-5 day intervals and government vessel voyages for pollution detection. Regular on-site inspections of ocean dumping operations and environmental emergencies are made in order to monitor compliance with DOE authorizations and their environmental impacts.

4. RESPONSE TIME:

Requirement:

- 6 hours maximum

Present Situation:

- DIAND and DOE: approximately 6 hours

SURVEILLANCE DATA ACQUISITION:

Present:

- Main surveillance system is DND aircraft (primarily Argus and Tracker). DND multi-tasks over 5000 hours per year of coastal and offshore surveillance patrols to include pollution surveillance and monitoring. (See description of DND system elsewhere in this report.)

- DOT, DFO, DND and other government vessels report pollution occurrences encountered. Use of ships for this purpose is of limited cost-effectiveness, however.

- ECAREG, NORDREG, VTM systems request all vessels to report pollution occurrences. (See description of these systems elsewhere in this report.)

- Most major spills are reported quickly to the responsible authorities. For minor spills (pumping of bilges, etc.) the difficulty lies in obtaining adequate evidence to detect and successfully prosecute the offender. Tracking is not a problem in inshore southern areas.

Possible Future Developments:

- DND aircraft acquisition will be based on military requirements. However, assuming continuation of multi-tasking arrangements, new DND aircraft (specifically the Aurora) could have enhanced capabilities which would improve pollution surveillance capabilities.

- Satellite systems might be useful for pollution surveillance because of wide area coverage and possible all weather capabilities (assuming SAR effectiveness). Applicability to Arctic and remote areas would be obvious. Satellite technology has yet to be fully investigated, however, and an operational system is unlikely before at least the mid 1980's.

- Dash 7R might be useful in pollution surveillance role.

- Promising results have been obtained with an experimental airborne oilspill monitoring package developed by EMR/CCRS with funding by the Unsolicited Proposal mechanism and the Arctic Marine Oilspill Program. Package is an array of sensors including: synthetic aperture radar; infrared line scanner; forward looking, low light level television; laser fluorosensor.

SURVEILLANCE DATA HANDLING/PROCESSING:

- DND aerial surveillance results reported to Command headquarters. Results distributed to DOT and other agencies as required. (See description of DND system, as well as DOT systems, elsewhere in this report.)

- Pollution control office in DOT has been recommended to improve coordination of various activities (including surveillance) associated with pollution control.

II INFORMATION SYSTEMS - REAL TIME

There is currently no real time on line system explicitly concerned with marine pollution. However, the DND system handles pollution surveillance on a routine basis, and pollution occurrences are also included in the information handled by ECAREG, NORDREG, and VTM centres of DOT/CCG, the agency charged with pollution containment and clean-up responsibilities.

DOT/CCG is currently investigating the possibility of establishing a program office to coordinate activities required to monitor and support pollution control standards.

III INFORMATION SYSTEMS - ARCHIVAL

(1) NEELS - National Emergencies Locator System (DOE/EPS) - NEELS is a computerized inventory of the type and location of equipment available, in both industry and government, for use in cleaning up spills of oil and other hazardous materials. The principal users are DOE/EPS and DOT regional offices which have direct access to the system. Other users include other government departments, provincial governments and industry.

(2) NATES - National Analysis of Trends in Emergencies (DOE/EPS) - This computerized data bank was developed by DOE/EPS in consultation with DOT and the Ontario Ministry of the Environment. The purpose of the system is to establish a data base of environmental accidents in order to analyse trends in environmental emergencies, to detect problem areas, and to plan and monitor remedial action. Information stored, which is entered by the observer of a pollution event, describes the location, type and circumstances of the spill. Work is currently underway to develop a spill simulation model.

(3) Ocean Dumping Permit Files (DOE/EPS) - This computerized data bank archives ocean dumping permit information on characteristics and composition of material dumped, characteristics of dump sites and method of dumping.

(4) Watenis - Water Effluent Information Systems (DOE/EPS) - This computerized data bank contains information on quantity and quality of water effluents for regulatory purposes. Two data bases are involved: (a) MUNDAT - general municipal water distribution and wastewater collection system; plants' water supply treatment and disposal, as well as operator training; (b) PETRO - petroleum refining plant specifications; monitoring of refinery effluents; studies on receiving water bodies.

(5) Hazmats - Hazardous Materials Information System (DOE/EPS) - Hazmats is a computerized inventory and description of some 3500 hazardous chemicals (environmental contaminants, pollutants and toxic substances).

(6) Drilling Authority Files and Notices of Commencement of Exploratory Work (DIAND) - This combined computerized and paper file system is described under DIAND's systems for non-renewable resource management. Included in the information maintained in these archives are: baseline data on marine biota, mammals and avi-fauna; data on ocean currents, ice conditions, tides and water quality.

(7) AMOP - Arctic Marine Oilspill Program (DOE/EPS) - AMOP is a major federally funded program to develop oilspill counter-measures in the Arctic. As part of the program, a major atlas (An Arctic Atlas: Background Information for Developing Marine Oil Spill Countermeasures) was compiled from a wide variety of existing material in many government, industry and university studies. The atlas maps for wide regions of the north parameters related to geology, petroleum development, meteorology, oceanography, ice, biology and social and economic factors. It is anticipated that the atlas could be regularly updated.

(8) MEDS - Marine Environment Data Services (DFO/OAS) - MEDS, a major marine environmental data archiving system, is described in detail in the section of this report dealing with cartography, hydrography, and oceanographic and marine geoscience surveys.

(9) Environmental baseline data, environmental impact and assessment data (DOE, DIAND, EMR): Significant marine environmental data, both for baseline purposes and for assessment of environmental impacts of marine transportation, ocean dumping, marine effluent discharges, and resource development projects, is being amassed and archived by departments with regulatory or environmental protection mandates. Among concerted environmental studies are the Beaufort Sea Environmental Studies (DOE), the Eastern Arctic Marine Environmental Studies (DIAND), and the Offshore Labrador Biological Studies (EMR).

The Environmental Assessment and Review Process (EARP) as established by Cabinet in 1973 applies, inter alia, to all projects developed in industry and government for exploitation of marine resources and utilization of the marine environment. This process involves the preparation of an Environmental Impact Statement (EIS) which must be supported by environmental studies. The data which forms the basis of an EIS must be submitted to the public sector when the EIS is submitted. Government agencies must, in the process of assessing and making a decision on an EIS, assess the data and the statements based on the data and advise the appropriate Minister as to the adequacy of the EIS and the studies supporting it.

The data must be available to anyone involved in the EARP processes including groups presenting briefs during the public hearing phase of the review process.

Development and Control of Navigation

OCEAN MANAGEMENT FUNCTION: Development and control of navigation

APPLICATION: Vessel surveillance and vessel traffic management

I SURVEILLANCE REQUIREMENTS

DEPARTMENTS: DOT/CCG (lead agency); other requirements by DFO, EMR, DIAND; surveillance by DOT, DFO, DND

SURVEILLANCE INFORMATION REQUIRED:

- Identification, characteristics, course and speed of all shipping, including drillships, work boats, data buoys.

SURVEILLANCE TARGETS:

- All types of ships from small trawlers about 20 metres long to very large crude carriers over 200 metres long. Special targets are research vessels for DIAND and DND and fishing vessels for DFO.
- Size, shape, superstructure and on-deck equipment or cargo can be used for classification and identification. Most vessels are made of steel or have steel structures on deck. There are many flat surfaces, joined at various angles, that make good radar reflectors. Wakes are an indication of vessel course. Cooperative vessels would carry electronic identification devices. Parts of ships will have temperatures 2°C or more above water surface temperature.

SURVEILLANCE INFORMATION SPECIFICATIONS:

1. GEOGRAPHICAL AREAS OF INTEREST:

Present: -See maps showing traffic densities on east and west coasts.

-ECAREG (Eastern Canada Traffic System)-area within 12 mile territorial sea on east coast south of 60°N but excluding waters covered by local VTM systems.

- NORDREG (Arctic Canada Traffic System) - covers area indicated in attached map (i.e. area within 100 mile zone covered by Arctic Shipping Pollution Prevention Regulations); operational during the Arctic shipping season.

- Local VTM Centres - areas covered: Bay of Fundy, Halifax Harbour, Strait of Canso, St. John's Harbour, Placentia Bay, Eastern Gulf of St. Lawrence, St. Lawrence River, Vancouver Harbour and approaches, west coast of Vancouver Island.

- DND surveillance responsibilities are for the sector from the North Pole between 30°W and 141°W, to lower limits of 40°N off east coast, 49°N off west coast.

Future: -DOT is now considering the establishment of further VTM zones at Prince Rupert, B.C.; Strait of Belle Isle and Conception Bay, Nfld.; and Sydney, N.S.

- DOT anticipates the need for higher levels of VTM in selected Arctic waters.

2. ACCURACY:

Requirement:

- Location: 2-4 km
- Temperature: 2°C

Present Situation:

- DOT: N.A.
- DND: Location: ½ - 5 km.

3. FREQUENCY OF OBSERVATION:

Requirements:

- DOT: 4 hours
- DND: 12 hours
- A ship travelling at 20 kt. will pass through the 200-mile zone in 10 hours by the shortest route. Vessels in high density inshore areas and those of special military interest require continuous surveillance.

Present Situation:

- DOT: N.A.
- DND: Varies, but every 84 hours is typical.

4. RESPONSE TIME:

Requirement:

- DOT: Immediate to 4 hours
- DND: 1 to 12 hours

Present Situation:

- DOT: N.A.
- DND: $\frac{1}{4}$ - 30 hrs.

SURVEILLANCE DATA ACQUISITION:

Present:

- ECAREG and NORDREG are large area vessel traffic management systems while numerous VTM centres handle marine traffic within limited local areas. ECAREG and NORDREG do not usually involve surveillance in the remote sensing mode, but rely primarily on VHF communications between vessels and the ECAREG and NORDREG centres (although relevant surveillance information is provided to DOT from the DND system). VTM centres carry out shore-based radar surveillance of vessels within their respective local traffic control zones. See following descriptions of all three systems.

- Additional surveillance information made available from other DOT sources and from other departments re: buoy movements (DFO, DPW), oil rigs (EMR, DIAND), location of fishing fleets (DFO), relevant classified information on a need-to-know basis (DND), positions and movements of all government vessels (all departments).

- DND considers surveillance to have the highest priority. Offshore surveillance by vessels, aircraft and other systems maintained on continuous basis, with results made available to civilian departments on a need-to-know basis.

- Vessel compliance rates:

  - VTM: close to 100% in mandatory reporting zones (Strait of Canso and St. Lawrence River); and 80% in other voluntary reporting zones.

- ECAREG: average 50% on voluntary basis but expected to be almost 100% with late 1978 introduction of mandatory reporting. Offenders of mandatory reporting will be monitored on basis of appearance in port.

- NORDREG: close to 100% on voluntary basis

Possible Future Developments:

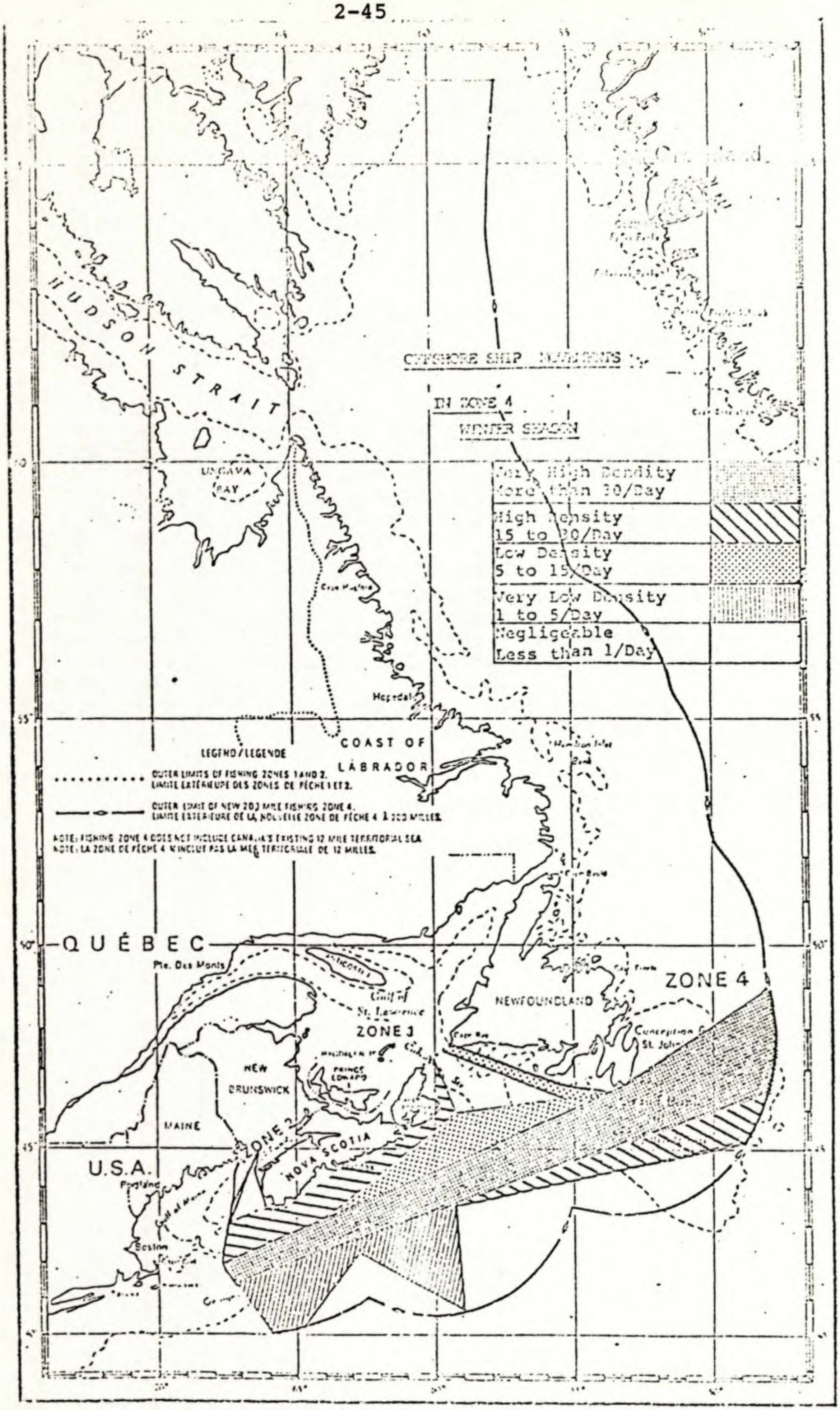
- DOT is presently drafting new VTM regulations which will make participation mandatory in all local VTM zones within a year.

- NORDREG will have mandatory reporting when enabling legislation is passed and when communication facilities in deficient areas of the Arctic are improved. A DOT priority is for improved navigation and communication systems for the Arctic.

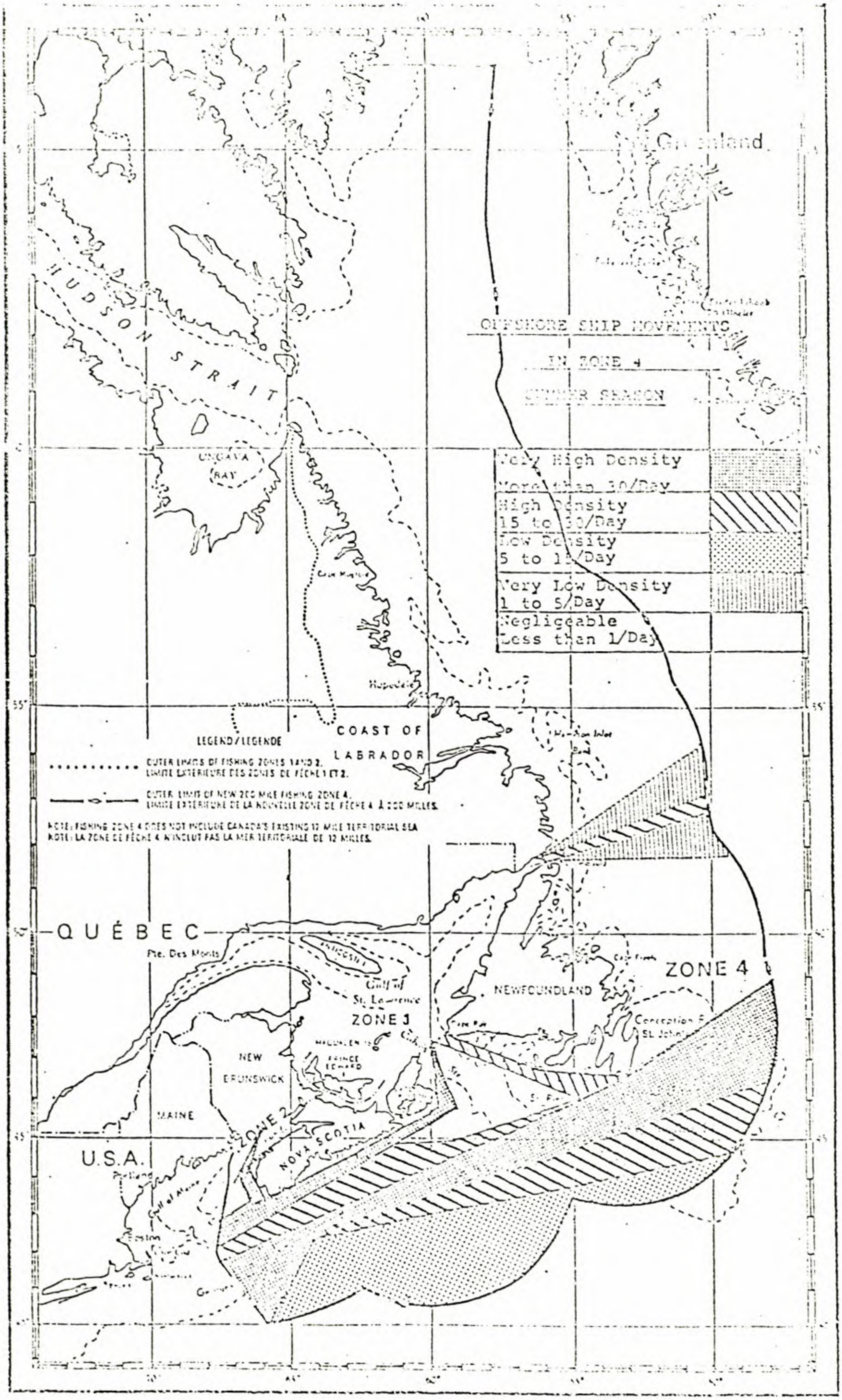
- Although DND equipment acquisition is based on military requirements, improved DND capabilities would normally result in improved surveillance assistance to civilian agencies. Anticipated surveillance system developments: Aurora, patrol frigates, extension northwards of long range radar on east and west coasts, possible NORAD AWACS system.

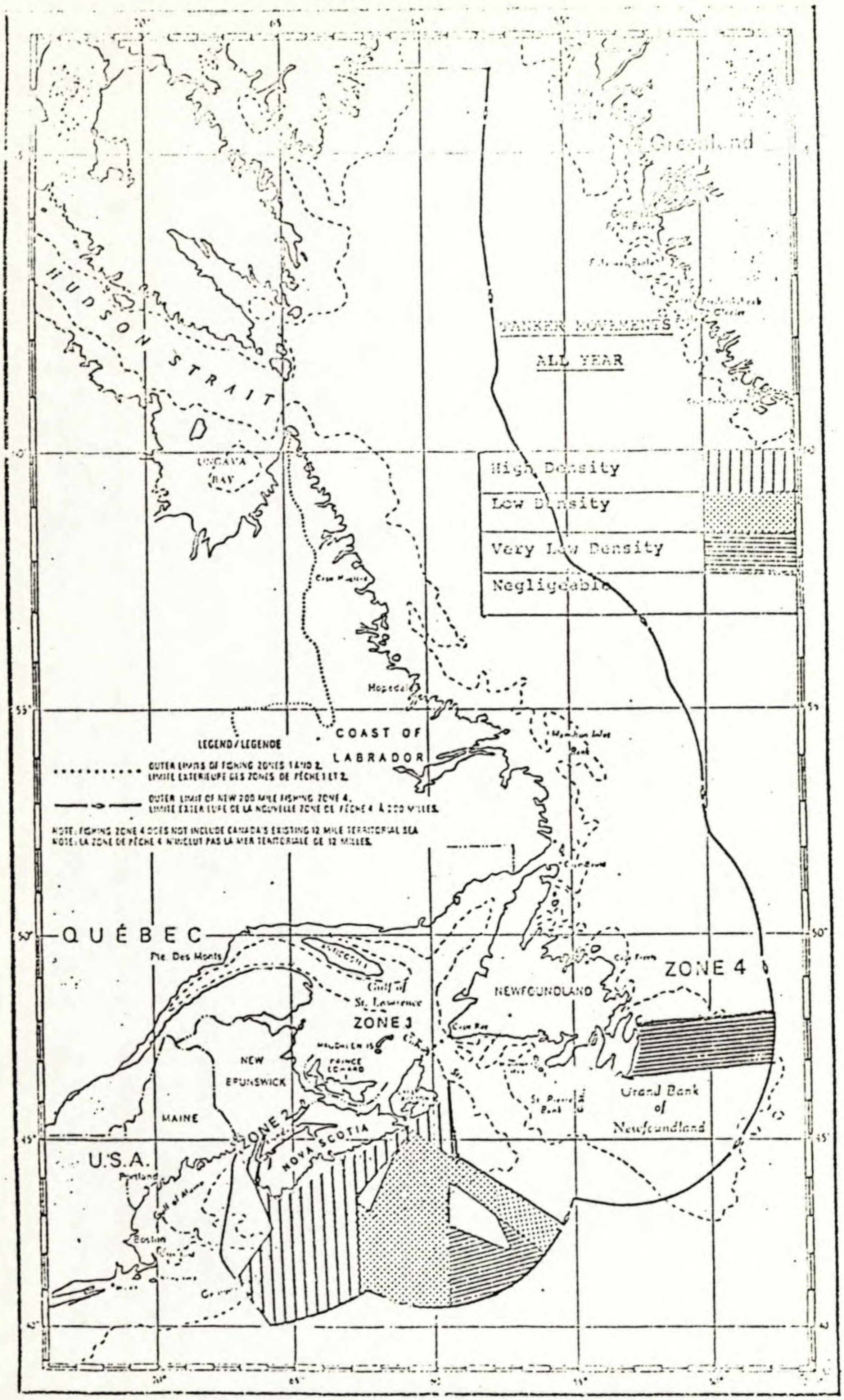
SURVEILLANCE DATA HANDLING/PROCESSING:

- See following system descriptions of VTM, ECAREG and NORDREG; for DND surveillance data acquisition and handling, see defence system description.



LIMITS OF CANADIAN FISHING ZONES / LIMITE DES ZONES DE PÊCHE CANADIENS


OFFSHORE SHIP MOVEMENTS
IN ZONE 4
SUMMER SEASON
Very High Density
More than 30/Day
High Density
15 to 30/Day
Low Density
5 to 15/Day
Very Low Density
1 to 5/Day
Negligeable
Less than 1/Day
Greenland
HUDSON STRAIT
UNGAVA BAY
Hopedale
COAST OF LABRADOR
LEGEND/LEGENDE
OUTER LIMITS OF FISHING ZONES 1 AND 2.
LIMITE EXTERIEURE DES ZONES DE PÊCHE 1 ET 2.
OUTER LIMIT OF NEW 200 MILE FISHING ZONE 4.
LIMITE EXTERIEURE DE LA NOUVELLE ZONE DE PÊCHE 4 À 200 MILLES.
NOTE: FISHING ZONE 4 DOES NOT INCLUDE CANADA'S EXISTING 12 MILE TERRITORIAL SEA
NOTE: LA ZONE DE PÊCHE 4 N'INCLUT PAS LA MER TERRITORIALE DE 12 MILLES.
QUÉBEC
Pte. Des Monts
ANTICOSTI
Gulf of St. Lawrence
ZONE 1
NEWFOUNDLAND
ZONE 4
NEW BRUNSWICK
PRINCE EDWARD I.
MAINE
ZONE 2
NOVA SCOTIA
U.S.A.
Portland
Gulf of Maine
Boston
55°



LIMITS OF CANADIAN FISHING ZONES / LIMITE DES ZONES DE PECHE CANADIENS

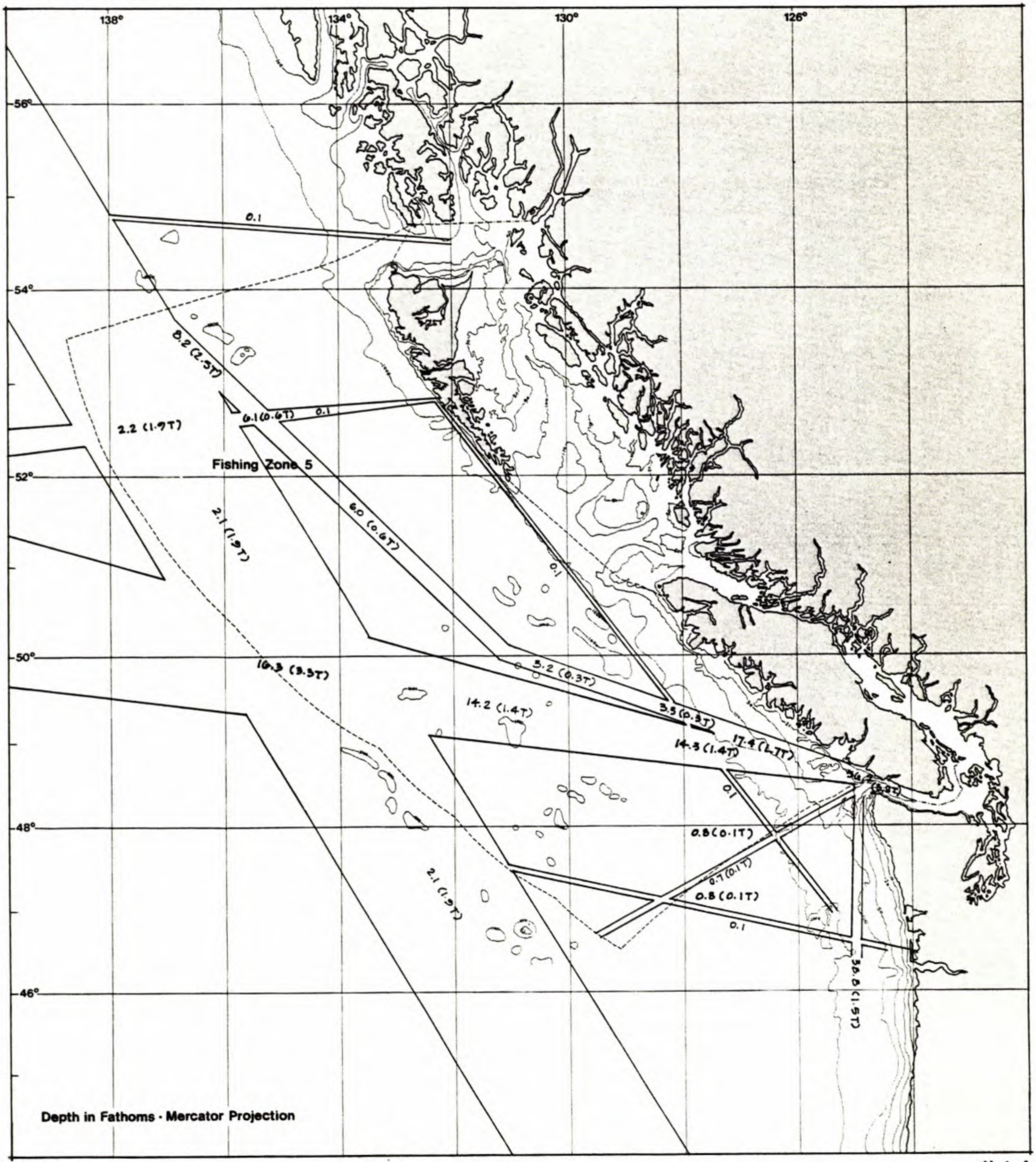
Vessel Source Pollution in Canadian Fishing Zone 5

Average Density of Ships: Annual

16.3 Total Number of Ships/Day
(3.3T) Number of Oil Tankers

Canadian Coast Guard
Fisheries and Marine Service

James Dobbin Associates
Coastal & Marine Resource Planners
Toronto, Ontario, Canada



II INFORMATION SYSTEMS - REAL TIME (VESSEL SURVEILLANCE AND VESSEL TRAFFIC MANAGEMENT)

Function: Development and Control of Navigation

Basis in Law: Canada Shipping Act, Navigable Waters Protection Act, Arctic Waters Pollution Prevention Act

Department: DOT - Canadian Coast Guard

System

ECAREG CANADA - The Eastern Canada Traffic System

Purpose:

- to provide real time information and advisory traffic services to mariners
- to screen shipping when it enters Canadian waters and to ensure compliance with regulations on vessel standards; system covers area within the 12 mile territorial sea on the east coast south of 60°N., but excluding waters under VTM centres (map attached).

Users:

- mariners on a real time basis.
- VTM centres and Coast Guard Operations Control Centres on a realtime basis.
- Search and Rescue RCC's as necessary.

Data Acquisition:

- vessel information provided to ECAREG by VHF communication with vessels (vessels over 500 tons, carrying pollutants or dangerous good-, or towing or pushing other vessels); VTM centres provide information as necessary.
- routine access to information products from other Transport Canada activities (e.g. monitoring of navigational aids, deployment of Coast Guard fleet) and from other government departments (e.g. ice and weather services of AES)

Data Handling, Processing, and Retrieval:

- ECAREG offices in St. John's, Dartmouth, Montreal, linked through computer network allowing on-line entering and extraction of information; centres have CRT terminals connected to Transport Canada Data Centre via Dataroute lines.
- ship to shore communications via VHF, retransmitted on Coast Guard communications network as necessary.
- data volumes for fiscal year 1977/78: vessel clearances issued-4225, vessels handled--31,756, ice routings issued-1209, defects deficiencies identified--404.

Parameters

Inputs: to ECAREG from vessels: request for clearance for vessels' intended routes through ECAREG zone, prior to entry to zone or port departure; vessel characteristics; course and destination information; cargo description; data on pollutants or dangerous cargoes; deficiencies in navigation, propulsion or manoeuvring equipment; conditions which are causing or may cause pollution; icebreaker and pilotage requirements; reports on accidents, pollution, hazards to navigation and improper functioning of navigation aids.

vessel information on permanent storage: physical and performance characteristics; navigation and communication equipment; owners, agents and other registry information; past history of Canadian regulation violations.

Other information provided to ECAREG on: positions and movements of government vessels; location of fishing fleets; position of drillships, work boats, data buoys; meteorological, oceanographic and ice information; navigation aids status.

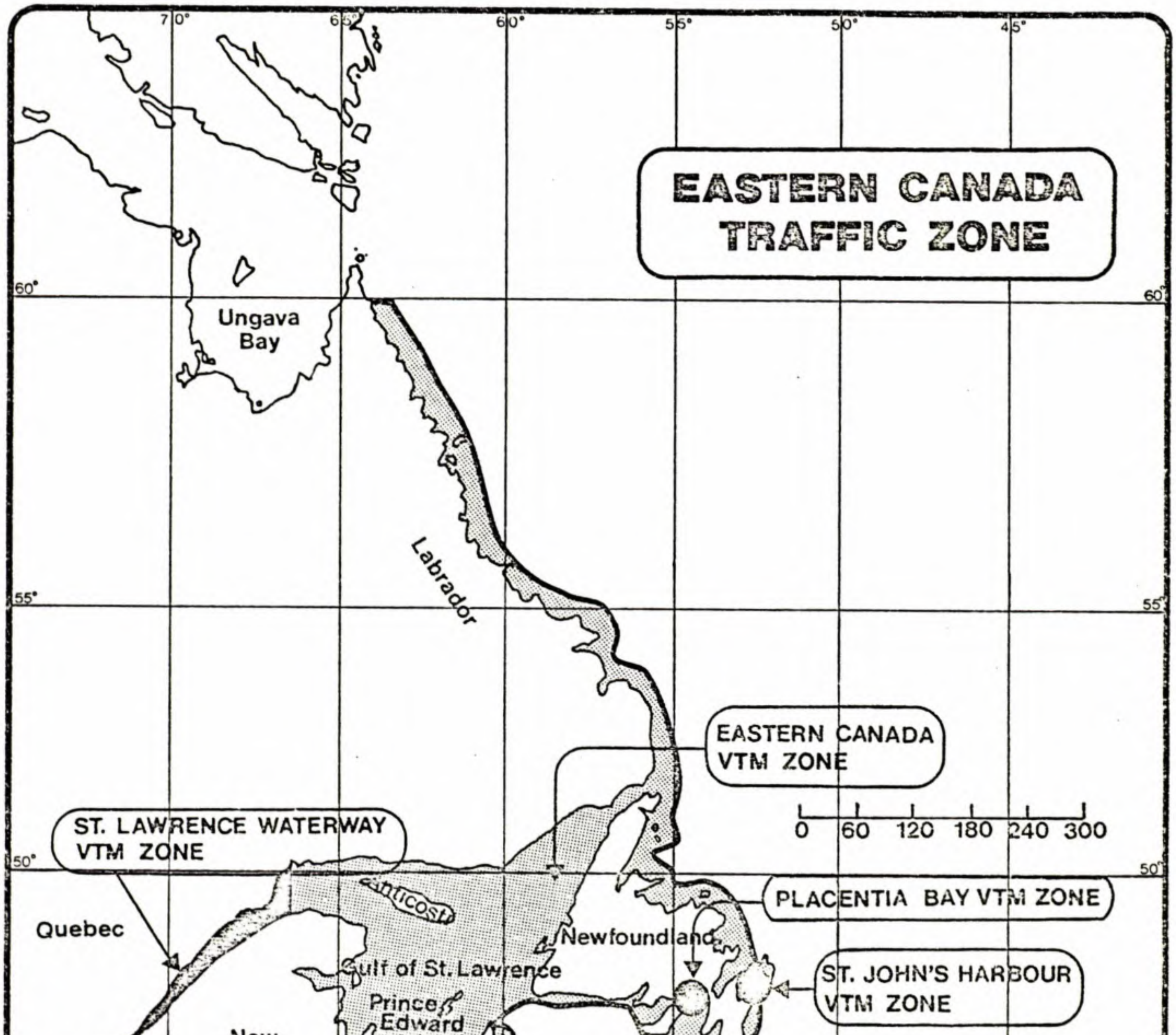
Outputs:

- information to mariners on: other vessel traffic; weather, ice and sea state conditions; navigation aids status; other factors likely to affect safety.
- information to Search and Rescue RCC's as necessary.
- information to various regulatory authorities as necessary.

Remarks

- has been mandatory since Oct. 1978.
- extension to 200 miles is envisaged.
- enhanced system effectiveness would derive from enhanced surveillance capabilities and improved services (e.g. ice and weather services; communications); successful SURSAT results could be important in this regard.

cont'd


EASTERN CANADA
TRAFFIC ZONE
Ungava Bay
Labrador
EASTERN CANADA VTM ZONE
0 60 120 180 240 300
ST. LAWRENCE WATERWAY VTM ZONE
Quebec
Anticosti
Newfoundland
PLACENTIA BAY VTM ZONE
Gulf of St. Lawrence
Prince Edward Island
ST. JOHN'S HARBOUR VTM ZONE
New Brunswick
Nova Scotia
STRAIT OF CANSO VTM ZONE
United States
HALIFAX HARBOUR VTM ZONE
BAY OF FUNDY VTM ZONE
70°
65°
60°
55°
50°
45°

Function: Development and Control of Navigation

Basis in Law: Canada Shipping Act Navigable Waters Protection Act, Arctic Waters Pollution Prevention Act

Department: DOT -- Canadian Coast Guard

System

NORDREG - The Arctic Canada Traffic System

Purpose:

- to provide real time information and advisory traffic services to mariners; to monitor vessel traffic and ensure compliance with regulations on vessel standards.
- system covers area indicated in attached chart.
- system operational only during Arctic Shipping season.

Users:

- mariners on a real time basis
- Coast Guard Operations Control Centres on a real time basis
- Search and Rescue RCC's as necessary.

Data Acquisition:

- vessel information provided to NORDREG by VHF communications with vessels (vessels over 300 tons, carrying pollutants or dangerous goods or towing or pushing other vessels); routine access to information products from other Transport Canada activities (e.g. monitoring of navigational aids, deployment of Coast Guard fleet) and from other government departments (e.g. ice and weather services of AES).

Data Handling, Processing and Retrieval:

- ship to shore communication via VHF, retransmitted on Coast Guard communications network as necessary.
- NORDREG centre in Frobisher Bay has terminal linked to Transport Canada Data Centre.

Parameters

Inputs:

- to NORDREG from vessels: request for clearance for vessels' intended routes through NORDREG zone, prior to entry to zone or port departure; vessel characteristics; course and destination information; cargo description; data on pollutants or dangerous cargoes; deficiencies in navigation, propulsion or manouvering equipment; conditions which are causing or may cause pollution; icebreaker and pilotage requirements; reports on accidents, pollution, hazards to navigation and improper functioning of navigation aids.
- vessel information on permanent storage: physical and performance characteristics; navigation and communication equipment; owners, agents and other registry information; past history of Canadian regulation violations.
- other information provided to NORDREG on: positions and movements of government vessels; location of fishing fleets; position of drill ships, work boats, data buoys; meteorological, oceanographic and ice information; navigation aids status.

Outputs:

- information to mariners on: other vessel traffic; weather, ice and sea state conditions; navigation aids status, other factors likely to affect safety.
- information to Search and Rescue RCC's as necessary
- information to various regulatory authorities as necessary.

Remarks

- compliance with NORDREG is currently voluntary; development of a traffic system with mandatory compliance is envisaged when traffic volume warrants and communications capabilities permit.
- enhanced system effectiveness would derive from surveillance capabilities and improved services (e.g. ice and weather services, communications); successful SURSAT results could be important in this regard.

cont'd

ARCTIC CANADA TRAFFIC ZONE (NORDREG CANADA)
N.B. For precise definition of seaward Boundary see <u>Arctic Waters Pollution Prevention Act.</u>

Function: Development and Control of Navigation

Basis in Law: Canada Shipping Act, Navigable Waters Protection Act, Arctic Waters Pollution Prevention Act

Department: DOT - Canadian Coast Guard

System

VTM (Vessel Traffic Management) Centres

Purpose:

- to provide real time information and advisory traffic services to mariners.
- to monitor vessel traffic and ensure compliance with regulations.
- to schedule marine traffic movements.

Users:

- mariners on a real time basis
- Coast Guard (in VTM centres) for monitoring and regulatory purposes.

Data Acquisition:

- shore-based radar monitoring of traffic at VTM centres; ship-to-shore radio communications between vessels and VTM centres.
- VTM centres cover the following areas: Bay of Fundy, Halifax Harbour, Strait of Canso, St. John's Harbour, Placentia Bay, Eastern Gulf of St. Lawrence, St. Lawrence River, Vancouver Harbour and approaches, west coast of Vancouver Island.

Data Handling, Storage and Retrieval:

- VTM centres equipped with VHF transmission and radar facilities locally and, in some cases, from remote sites; mini-computers and associated display equipment in VTM centres allow vessel tracking.
- data on vessels maintained in VTM centre only when vessel is in area controlled by centre
- data handling volumes depend on traffic rates.
- VTM provisions apply to: vessels 20 metres or more in length, towing vessels 8 metres or more in length, towing vessels less than 8 metres in length which are towing wide or long vessels or objects, air cushion vehicles 8 metres or more in length.

Parameters

Inputs: (to VTM centres):

- requests for clearance from vessels: entering or getting underway in VTM zone, proceeding to or leaving a berth, proceeding after being stranded or involved in a collision, proceeding after suffering disabling of navigation or manoeuvering equipment.
- prior to entry into VTM zone vessels provide VTM centre with data on: vessel characteristics; pollutants in cargo; deficiencies in navigational, propulsion or manouvering equipment; any pollutant leakage.
- vessels report to VTM centre knowledge of accidents, obstructions to navigation, non-functioning navigation aids, pollution occurrences, visibility reduction.

Outputs: (from VTM centres)

- information to vessels in VTM zone on: all traffic in their vicinity, hazards to navigation, Notices to Mariners, expected movements of vessels which may constitute special hazards.

Remarks

- vessels must report to VTM centres for Strait of Canso and St. Lawrence River on mandatory basis; reporting to all other centres is voluntary at present, but DOT is considering mandatory reporting for all VTM zones.

III INFORMATION SYSTEMS - ARCHIVAL (Vessel surveillance and vessel traffic management)

The Coast Guard maintains a number of shipping related data banks which, inter alia, can be accessed by the real time vessel traffic management systems. These include:

(1) Non-Canadian Compliance Certificates - This computer data base contains information on foreign tankers which have been issued with certificates permitting them to navigate in Canadian waters.

(2) Steamship Inspection Reporting System - This computerized data bank, accessible by regional Coast Guard offices, contains details of first and subsequent inspections of ships as required by the Canada Shipping Act.

(3) Registry of Ships - This archive, currently manual, maintains registry data on Canadian vessels. Implementation of the proposed Maritime Code Act would probably result in establishment of an automated registry.

(4) Record of Crew Examinations - This data bank, now being developed, would record all crew exemptions issued by the Coast Guard's Ship Safety Branch, and provide data on availability of certificated marine personnel.

OCEAN MANAGEMENT FUNCTION: Development and control of navigation

APPLICATION: Surveillance of aids to navigation system

I SURVEILLANCE REQUIREMENTS

DEPARTMENT: DOT/CCG

SURVEILLANCE INFORMATION REQUIRED:

- Geographical position and operational status of aids-to-navigation i.e. improper positioning, malfunctioning, outages, damage, absence, etc.

- Whether lights and/or sound systems are functioning.

SURVEILLANCE TARGETS:

- Steel cylinder buoys up to 3 metres *(original requirement to Task Force: 4 metres)* in diameter surmounted by a 4 metre angle iron framework which carries a lamp and in many cases a standard aluminum 0.5 metre radar reflector. There are over 100 buoys located from 7-20 nautical miles offshore, about 15 of which go adrift each year. Each buoy is worth about $10,000-$15,000.

- Lights and sound systems i.e. shore lights, radio beacons, radar beacons.

SURVEILLANCE INFORMATION SPECIFICATIONS:

1. GEOGRAPHICAL AREAS OF INTEREST:

   Present: -All navigable waters under Canadian jurisdiction to about 20 nautical miles offshore.

   -St. Lawrence River is a high aids density area and the Arctic is a low aids density area.

   Future: -Arctic surveillance requirements are strictly seasonal at present but this could change with increased

Arctic exploration and activities. In addition, the more extensive nav aids system which would be needed for projected Arctic operations would probably require an increased level of surveillance activities.

2. ACCURACY:

Requirement:

- Position of inshore buoys: 3 metres *(original requirement to Task Force: 1 metre)*

- Position of offshore buoys: 50 metres

Presently Obtained:

- Current accuracies range from a minimum of 5-10 metres to 50 metres plus.

3. FREQUENCY OF OBSERVATION:

Requirement:

- Inshore buoys: at least every 3 hours

- Offshore buoys: 48-72 hours (If detected within this time period, an offshore buoy going adrift can be easily recovered by ship.)

Presently Obtained:

- The present frequencies of observation are every 2-4 months by CCG vessels; daily and weekly by local traffic; at least monthly by local contractors ; and continuously by VTM radar where available.

- There are no seasonal variations in frequency requirements.

4. RESPONSE TIME:

Requirement:

- 3 hours from observation to reporting.

Presently Obtained:

- Present response time can vary from 0 to weeks, depending on circumstances, detection and reporting of aid malfunction.

- There is no significant seasonal variation in present response times.

SURVEILLANCE DATA ACQUISITION:

Present:

- See following system description.
- Monitoring currently consist of regular checks by CCG vessels; reports of local marine traffic to CCG; local contractors; and automatic radar readouts at VTM centres and CCG radio stations.

- Area coverage position fixing systems (Decca Navigator and Loran A on the east coast and Loran C on the west coast) and radio beacons are monitored by stations in each chain, by dedicated remote monitoring site, or at a CCG radio station.

Possible Future Developments:

- Buoys could be equipped with appropriate radar reflectors.

- A prototype system for monitoring buoy operation is now under evaluation.

- Loran C may possibly be deployed on the east coast.

- A satellite Global Positioning System could achieve operational status by the early to mid 1980's.

- DOT and DOC have studied a positive 'off position/ malfunction' detection system for buoy monitoring using the proposed UHF communication satellite.

- CCG has expressed interest in a communications link to lighthouses and other fixed aids.

SURVEILLANCE DATA HANDLING/PROCESSING:

- See following system description.

II INFORMATION SYSTEMS - REAL TIME (SURVEILLANCE OF AIDS TO NAVIGATION)

Function: Development and Control of Navigation

Basis in Law: Canada Shipping Act, Navigable Waters Protection Act, Arctic Waters Pollution Prevention Act

Department: DOT - Canadian Coast Guard

System

AIDS TO NAVIGATION

Purpose:

- to provide information on the status of the Coast Guard's aids-to-navigation system;
- to provide information on the aids system required by users.

Users:

- DOT (Coast Guard), mariners; on real-time basis.

Data Acquisition:

- aids system consists of: a large number of buoys, shore lights, radio beacons and radar beacons for position fixing at key navigational points, on east, west and Arctic coasts and in the Great Lakes; Decca Navigator and Loran A (part of chain in Greenland) area coverage position fixing systems on east coast; Loran C (part of U.S. chain) area coverage position fixing system on west coast.

- status of aids information: automatic readout at VTM centres and Coast Guard radio stations on status of many electronic and shore light nav aids; other information gathered through aids-checking operations by the Coast Guard and from mariners' reports to Coast Guard (via Coast Guard radio stations) on system anomalies.

- status of aids and other information on aids disseminated to users by Coast Guard radio stations, VTM centres, NORDREG and ECAREG centres.

Data Handling, Processing and Retrieval:

- information on aids status maintained and broadcast to users on real time basis at VTM centres, ECAREG and NORDREG centres, Coast Guard radio stations.

Parameters

Inputs:

- to Coast Guard: automatic read-outs on status of electronic and shore light nav. aids, information on aids malfunctions, outages, damage, improper positioning, absence.

Outputs:

- to mariners: aids status and other pertinent information in the form of radio messages, Notices to Mariners, Notices to Shipping, Radio Aids to Marine Navigation Bulletins.

Remarks

III INFORMATION SYSTEMS - ARCHIVAL (Surveillance of aids to navigation)

The Coast Guard maintains archived information on nav aids systems and historical information on traffic patterns. This information can be accessed by real time Coast Guard systems as required.

OCEAN MANAGEMENT FUNCTION: Development and control of navigation

APPLICATION: Surveillance of man-made hazards to navigation. (also has implications for protection of the marine environment)

I SURVEILLANCE REQUIREMENTS

DEPARTMENTS: DOT/CCG (lead agency), DND, DIAND, DFO, EMR, DOE

SURVEILLANCE INFORMATION REQUIRED:

- Location, movements, classification and/or identification of flotsam which could pose a hazard to navigation (or constitute a pollution source).

SURVEILLANCE TARGETS:

- Man-made objects such as oil drums, large tanks, containers and other debris. Sizes of interest are from 1-2 metres up to 10 metres or larger. Some targets such as oil drums, tanks, containers are metallic and of such a shape as to possibly provide good radar targets. Other targets such as hatch covers, large logs (dead heads"), small boats would be difficult to detect by radar.
- *Icebergs, bergy bits and growlers were included under this application in the Task Force Report. They are now included in the section on ice reports and forecasts elsewhere in this Appendix.*

SURVEILLANCE INFORMATION SPECIFICATIONS:

1. GEOGRAPHICAL AREAS OF INTEREST:

   Present and Future: All navigable waters under Canadian jurisdiction out to 200 nautical miles.

2. ACCURACY:

   Requirement:

   - Location accuracy to 500 metres. DOT/CCG considers this to be asking for a lot.

   Present Situation:

   - N.A.

3. FREQUENCY OF OBSERVATION:

Requirement:

- Daily

Present Situation:

- As frequently as possible.

4. RESPONSE TIME:

Requirement:

- 4-6 hours

Present Situation:

- As soon as possible

SURVEILLANCE DATA ACQUISITION:

Present:

- Reports from military and civilian vessels and aircraft (including DND patrol aircraft) to VTM, ECAREG and NORDREG centres when necessary on flotsam as a hazard to navigation. Data is handled by teletype, telephone or other normal communication format.

- See system descriptions for DND, VTM, ECAREG and NORDREG elsewhere in this report.

Possible Future Developments:

- Satellite detection and surveillance of flotsam could be useful.

OCEAN MANAGEMENT FUNCTION: Development and Control of Navigation

APPLICATION: Marine transportation and facilities - siltation/sedimentation surveillance

I SURVEILLANCE REQUIREMENTS

DEPARTMENTS: DOT/CCG, also DPW (for engineering purposes), DFO, EMR

SURVEILLANCE INFORMATION REQUIRED:

- The extent, nature, growth and cause of siltation/sedimentation which may endanger or restrict the flow of marine traffic or be a factor in decisions on port or waterway development.

SURVEILLANCE TARGETS:

- The horizontal and vertical extent and the horizontal and vertical growth rates of siltation/sedimentation are required. Here is a strategic requirement for historical data for planning port and waterway developments, especially in remote areas, as well as a tactical requirement for maintenance of existing ports and waterways.

- Structure of river plumes.

SURVEILLANCE INFORMATION SPECIFICATIONS:

1. GEOGRAPHICAL AREAS OF INTEREST:

   Present: - All navigable or potentially navigable Canadian waters. Siltation is usually heavier during spring break-up and summer storms. In winter the rivers are normally covered by ice, thereby limiting surveillance opportunities.

   Future: - All navigable or potentially navigable Canadian waters. Anticipated Arctic requirements include more information on Mackenzie delta for both navigation and oil drilling activities.

2. ACCURACY:

Requirements:

- Strategic: some tens of metres

- Tactical: 2 metres horizontal and 0.3 metres vertical

Present Situation:

- N.A.

3. FREQUENCY OF OBSERVATION:

Requirements:

- Strategic: monthly

- Tactical: daily - In coastal areas DFO may require up to 4 observations per day to observe tidal effects.

Present Situation:

- N.A.

4. RESPONSE TIME:

Requirement:

- N.A.

Present Situation:

- N.A.

SURVEILLANCE DATA ACQUISITION:

Present:

- Siltation information is presently obtained by DFO, EMR and DOT through field investigations.

- The present practice is to obtain periodic aerial photographs (including IR) of critical areas. The main objective of this requirement is to obtain adequate geographic coverage for planning new ports and waterways and general "time series" data for existing ports and waterways. Periodic large area coverage, as obtained by satellite, is very useful. (An example of such an application is tracing plumes from dredging work.) However, DPW indicates that, while the monitoring of sea bottom sedimentation and the density and extent of suspended sediment is desirable, the requirement for selective penetration of varying depths of water limits the usefulness of existing remote sensing techniques.

- Plumes from siltation sources are often readily visible in LANDSAT satellite imagery. In shallow water the growth of siltation itself may be detectable. LANDSAT resolution is presently acceptable to DFO.

- In winter, when rivers are normally covered up by ice, it is doubtful if any siltation information can be obtained through satellites.

Possible Future Developments:

- N.A.

SURVEILLANCE DATA HANDLING/PROCESSING:

- Data format: standard photographic images kept at the headquarters of each initiating department.

- Data handling/processing requirements: nil.

Defence

OCEAN MANAGEMENT FUNCTION: Defence

I SURVEILLANCE REQUIREMENTS

APPLICATIONS:
a. Military intelligence of naval activities
b. Subsurface ocean surveillance (military)
c. Surveillance of areas assigned to Canada by the United Nations for peacekeeping purposes.

DEPARTMENT: DND

SURVEILLANCE INFORMATION REQUIRED, SURVEILLANCE TARGETS, SURVEILLANCE INFORMATION SPECIFICATION:

Original details on these items were contained in a "Restricted" version of the Surveillance Satellite Task Force Report Satellites and Sovereignty. In order to maintain the non-classified status of the present report, these details are not re-produced here. However, DND has indicated that these requirements, as given to the Task Force, remain unchanged.

SURVEILLANCE DATA ACQUISITION, SURVEILLANCE DATA HANDLING/PROCESSING:

- Details of data acquisition and handling for military surveillance requirements are given in the system description which follows.

- DND information acquisition and processing activities which aid civilian departments in meeting their surveillance requirements (i.e. fisheries surveillance, pollution surveillance, oceanographic and weather observations, surveillance of offshore oil exploration, wild life surveys) are incorporated in the following description of the defence system.

- Major issue is whether DND surveillance, which is justified primarily on military grounds, will continue to provide information compatible with civilian requirements.

II INTEGRATED DESCRIPTION OF REAL TIME AND ARCHIVAL INFORMATION SYSTEMS

Function: Defence

Basis in Law:

Department: DND

System

DND Operations as an Integrated System

Purpose:

- to ensure and enhance the security of Canada and contribute to the maintenance of world peace.
- to provide search and rescue services.
- to supplement and support civilian authorities in maintaining surveillance and preserving control over areas of Canadian jurisdiction.
- to assist civilian authorities in the event of emergencies or disasters

Users:

- DND, civilian departments, Canada's military allies.

Data Acquisition:

- air: - Argus aircraft (radar, photo, visual, underwater sound detection and recording, radio frequency monitoring capabilities, position fixing, meteorological and oceanographic observations) Tracker aircraft (radar, visual, radio frequency monitoring, position fixing, pollution observation, meteorological and oceanographic observations) Sea King helicopters (radar, sonar, visual, photo, radio frequency monitoring, pollution observation and verification capabilities).
- vessels: combatant vessels (DDH 280, 265, 205 class; DDE 261 class, IRE 257 class); operational support ships (AOR 508, 509/510 class); Oberon Class Submarines; various training, research and auxiliary vessels - capabilities in: position fixing, radar surveillance of aircraft, photo, radio frequency monitoring, meteorological and oceanographic observations; pollution observation and verification, sonar and visual.
- radar: coastal radars on east and west coasts; cooperation under NORAD in DEW Line, Alaskan, and Over-the-Horizon radar systems.
- HF/DF Network: a high frequency direction finding net providing generalized location and identification data; Canada participates with other nations for search and rescue operations.

Parameters

Inputs:

- direct observations of surface subsurface, and air targets for military purposes.
- readouts from various platform mounted sensors for analysis of surface, subsurface, and air targets for military purposes.
- data/information on: ice, meteorological and oceanographic conditions, fishing activity, pollution occurrences, wild life counts, general shipping activity.

Outputs:

- analysis of inputs for military command, control and operations purposes.
- reports to: DFO on fisheries activities and violations; DOT on shipping and pollution occurrences; DOE - AES on ice and meteorological conditions; DOE on wild life survey counts.

Remarks

Anticipated System Developments:

Platforms:

- new patrol frigates
- LRPA aircraft
- AWACS Airborne Early Warning and Control Systems
- extension northwards of Canadian long-range radar on east and west coasts.

Data Handling:

- MCOIN II ADP system to become operational at MARCOM HQ by 1982.
- centres in COMOX, British Columbia and Greenwood, N.S. to be operational in 1981 for computer-based reduction and analysis of data from LRPA.

cont'd

Function: Defence

Basis in Law:

Department: DND

System	Parameters	Remarks
- SOSUS: sound surveillance system designed primarily for underwater use; not particularly suitable for surface target surveillance; each station operates as part of a multi-national network.		
- Satellite Early Warning System - information for military purposes under NORAD; some unclassified information available.		
Data Handling, Processing and Retrieval:		
- Operations Centres in Halifax (MARCOM HQ) and Esquimalt (MARPAC HQ) coordinate and control military surface, sub-surface, and maritime air units; data/information acquired by platforms reported to MARCOM/MARPAC HQ on real time basis as necessary.		
- MARCOM HQ has ADP Support system		
- both HF/DF and SOSUS information are analysed and collated at the respective local stations before transmission to MARCOM/MARPAC HQ on real time basis as necessary.		
- data/information acquired by DND platforms on fisheries activity and violations may be transmitted directly to DFO or to DFO through MARCOM/MARPAC HQ; data/information acquired by DND platforms on marine pollution is transmitted to DOT through MARCOM/MARPAC HQ; ice reconnaissance and meteorological data to DFE-AES.		
- DND operates Metoc meterological oceanographic centres and rescue coordination centres for Search and Rescue; these are described elsewhere.		

Ocean Service Activities

OCEAN MANAGEMENT FUNCTION: Ocean Service Activities

APPLICATION: Weather and sea-state reporting and prediction services in support of all marine operations, including airborne services.

I SURVEILLANCE REQUIREMENTS

DEPARTMENTS: DOE/AES and DND provide forecast services; all other departments involved in ocean management are users.

SURVEILLANCE INFORMATION REQUIRED:

- The standard format is unsuitable for recording these requirements.
- All departments have needs for weather and sea-state information for all ocean activities. These services are normally provided by DOE/AES. DND METOC Centres provide weather, sea-state and oceanographic services in support of DND operations.
- Requirements include a large variety of measurable parameters, many of which are correlated, so that many possible substitutions exist between input data.
- Generally speaking, users of weather and sea-state data need to know some or all of the following parameters, both current and forecast:

  Air temperature
  Air pressure
  Air humidity
  Wind direction, speed and fluctuations
  Visibility
  Cloud type and extent
  Precipitation type, intensity and duration
  Wave heights
  Wave lengths
  Sea current direction and speed.

- Other data required by specific users include sea temperatures (both surface and sub-surface), upper atmosphere pressures and wind speeds, etc.
- AES requirements differ from operational end-users in as much as there are a wide variety of data which can be used and there are, as mentioned above, very few unique sets. The

large numerical forecasting models being used or developed require as input quantitative measures of temperature, pressure and water content of the atmosphere, wind velocity profiles and other data on a global or hemispheric basis, using three-dimensional grids with spacings from 100 to 500 km. From these data, general forecasts for periods ranging from 12 to 96 hours are produced.

- These large-area forecasts are then used by regional centres and combined with local knowledge, more recent observations and qualitative data to produce shorter-term more detailed regional forecasts.

- At the national level, there are currently more data available (from both national and international sources) than can be effectively used within budgetary and manpower constraints. Some additional data, such as measures of surface wind velocities, especially in areas of current sparse coverage, such as the North Pacific, would, however, be useful.

- At the regional level, additional data on sea-state and wind and temperature distribution at sea would be very useful.

SPECIFIC DEPARTMENTAL REQUIREMENTS:

- In addition to the ongoing requirements of all levels of government, industry and the public for weather information and forecasts, the following specific requirements have been identified:

EMR/RMCB:

- Offshore production facilities will probably require more offshore data from either weather ships, buoys or satellites for improved weather forecasts.

DFO:

- Accurate ten day weather forecasts would be useful for fisheries operations.

DIAND:

- DIAND has special requirements for 4-6 hour forecasts for ice-islands and drilling platforms. These requirements are currently being met by industry and seconded personnel from AES. Private sector organizations are expected to be engaged to a greater extent in the future to meet special requirements in specific areas where operations are being carried out.

SURVEILLANCE INFORMATION SPECIFICATIONS - AES:

1. GEOGRAPHICAL AREAS OF INTEREST:

Present: -St. Lawrence River and Great Lakes as well as all Canadian coastal waters extended out to 200 miles.

Future: -no further expansion expected at this time.

2. ACCURACY:

- The required accuracy for all observations has been agreed upon internationally by the World Meteorological Organization and is published in the WMO Guide to Meteorological Instrumentation and Observing Practices (WMO 8 TP 3 Chapter 17 - Marine Observations and in WMO 49 Volume 1 Technical Regulations).

3. FREQUENCY OF OBSERVATION:

- The above WMO manuals include information on the frequency of observation required.

4. RESPONSE TIME:

- For local weather and sea-state forecasts observations must be available at the regional forecast centres within half an hour of the observation time.

- Large scale numerical weather prediction systems assimilate data on a six-hourly cycle.

SURVEILLANCE DATA ACQUISITION:

Present:

- See following system descriptions of AES and METOC centres.

- Offshore surface weather and sea-state observations are obtained from ocean stations, ships of opportunity and buoys. Aircraft observations are provided by most commercial and military aircraft over the ocean areas. In addition, meteorology satellites provide imagery, both visible and infra-red. Atmospheric temperature and humidity soundings and upper-air winds are inferred from cloud motions.

Future:

- Follow on SEASAT type satellites will provide sea-state and surface wind information over the oceans.

- DCP re-transmission systems on satellites will provide a capability to automate observations on ships of opportunity and moored and drifting buoys.

- Improved data analysis techniques will permit greater exploitation of radiance data from satellites by improving the accuracy of the derived meteorological fields.

SURVEILLANCE DATA HANDLING/PROCESSING:

- See following system descriptions of AES and METOC centres.

- AES maintains numerous large archival data banks. These are considered as part of the integrated AES system and are included in the following system description.

- AES has a comprehensive data acquisition, communication, processing and distribution system in place capable of providing real-time weather and sea-state information over the ocean areas of the globe. Forecasts produced by AES are limited to areas around the coasts of Canada; forecasts for other areas are available via the international meteorological communications networks. They are normally distributed via teletype and facsimile links.

- Climatological data are available from the AES data banks and climatological services of other countries on request, normally on computer compatible tape.

- AES has instituted the Canadian Climate Program, a major program of climatological research and services.

- The AES data handling/processing systems could be expanded to include other environmental parameters of comparable temporal and spatial resolutions.

II INTEGRATED DESCRIPTION OF REAL TIME AND ARCHIVAL SYSTEMS

Function: SERVICES: Weather Forecasting

Basis in Law: Cabinet, Treasury Board Directives

Department: DOE/AES

System

System:

- AES as a single integrated system

Purpose:

- acquisition and archiving of basic meteorological data
- analysis, description, prediction of atmospheric conditions in navigable waters
- dissemination of current and predicted meteorological conditions to users
- provision of historical meteorological data and information

Users:

- the general public
- industry (e.g., aviation, shipping, construction, etc.)
- many special users, for some of which "Special Function Centres" have been established.
- AES outputs are primary inputs in other ocean information systems (e.g. Vessel Traffic Management, Search and Rescue).

Data Acquisition

- data and processed data products received on world wide basis from Global Observing System, Global Telecommunications System, and Global Data Processing System; about 75 per cent of AES data obtained from abroad.
- AES data acquisition: 36 land stations and Ocean Station "Papa" for upper air data; 245 Canadian land stations, 200 to 365 ships of opportunity provide 3 or 6-hourly readings of meteorological parameters; 32 automatic stations and up to 200 stations provide hourly readings; 10 weather radars; 2 stations receive HRPT data and 2 other stations receive APT data from U.S. polar orbiting meteorological satellites;
- real time or near real time reports from aircraft, industry, agriculture, forestry, provincial agencies, shipping;
- climatological data (non-real time basis): 2313 stations providing precipitation and/or temperature; supplementary observations: wind-235, soil temperature-69, evaporation 143, sunshine-310, radiation-54 air quality-8.

Parameters

Inputs:

- about 75 per cent of AES data/information obtained from abroad
- meteorological data from AES acquisition network: temperature, humidity, air pressure, winds, visibility, weather, precipitation, cloud conditions, sea state, water temperature.
- visual and infra red APT data and multi-spectral HRPT data readouts from polar orbiting satellites.
- visual, and infrared data from GOES satellites; direct GOES VISSR read-out in Toronto; planned direct read-out in Vancouver.
- upper air temperature and humidity
- wind, pressure, water, and air temperature from experimental data buoys
- climatological data: temperature, precipitation, soil temperature, evaporation, sunshine, radiation, air quality
- data and output products from Global Observing System, Global Telecommunications System, Global Data Processing System.

Outputs:

- high seas weather and sea bulletins including warnings; coastal zone weather and sea bulletins including warnings, reports of present marine weather conditions; special marine meteorological services; general marine weather/climatology summaries.
- special marine forecast services, specially processed climatological information on cost recovery basis.

Remarks

- systems are under development to combine: weather satellite and weather radar data; satellite sounding and rawinsonde sounding systems.
- replacement of weather ships (Ocean Station "Papa") by alternative techniques will begin in 1979/80.
- AES currently conducting study on various possible designs of observation network.
- developments in communications and data handling technologies are required to cope with high data flow rate.

cont'd

Function: SERVICES: Weather Forecasting

Basis in Law: Cabinet, Treasury Board Directives

Department: DOE/AES

System	Parameters	Remarks

Data Handling, Processing and Retrieval

- system, as outlined in accompanying diagram, has key elements as follows:

Canadian Meteorological Centre (CMC), (Montreal)

- centralized production component, interacts with World Meteorological Centre (WMC); provides general and specialized real time support to other components of AES system; interfaces directly with users of its computer products (e.g. computerized air traffic control, private meteorological organizations); carries out real-time monitoring of Canadian portions of Global Observation System and Global Telecommunications System.

Canadian Climate Centre (CCC) (Downsview, Ontario)

- centralized component now in early stages of organization; provides climatological information as inputs to other system components; carries out non-real-time monitoring of Canadian data acquisition system; provides climatic bulletins, long term forecasts, climatic impact forecasts for regional areas.

Special Function Centres

- concentrate special skills on problems related to data interpretation, severe weather, geography, scale; existing centres: Satellite Data Laboratory (Downsview) Great Lakes Storm Surge (Toronto), Severe Weather (Winnipeg), Ice Forecasting (Ottawa), Beaufort Sea (Inuvik) DND Metoc Centres (Halifax, Esquimault).

- Ice Forecasting and Metoc Centres described separately in more detail.

- Beaufort Sea Centre: funded by oil companies; local observation network operated by the companies provides data which AES integrates with other information to develop ice and weather forecasts for the offshore drilling areas.

Weather Centres (6), Forecast Offices:

- provide regional and local forecasts for various users; each office has computer system for data processing and regional numerical weather prediction; Weather Centres at Vancouver, Edmonton, Winnipeg, Toronto, Montreal, Halifax; major Forecast Officers in Gander, Whitehorse.

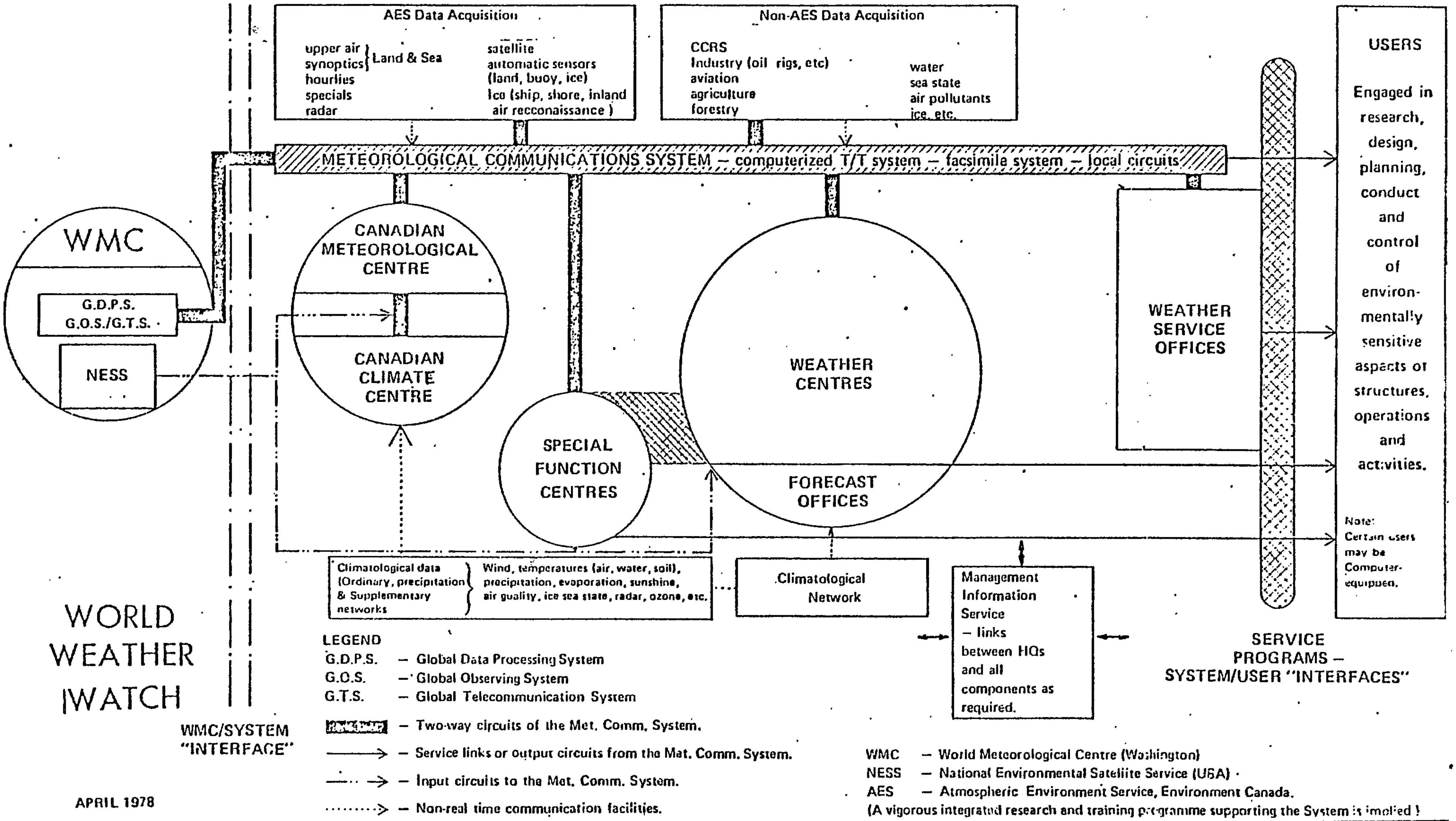
Weather Service Offices:

- advise and assist on meteorological factors affecting activities in area served (e.g. aviation briefing offices, city weather offices)

cont'd

AES INTEGRATED SYSTEM FOR PROCESSING AND DISTRIBUTING METEOROLOGICAL INFORMATION

DATA ACQUISITION, EXCHANGE AND DISTRIBUTING FACILITIES; BASIC ORGANIZATIONAL COMPONENTS



APRIL 1978

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Function: SERVICES: Weather and Sea State Forecasting, and Oceanographic Information

Basis in Law: Interdepartmental agreement approved by Treasury Board

Department: DND

System

Meteorological and Oceanographic (METOC) Centres

Purpose:

- to provide meteorological, sea state and oceanographic services in support of DND operations and activities
- to fulfil Canada's responsibility to provide a Fleet Weather Central and Oceanographic Information Centre in support of NATO
- to evaluate meteorological and oceanographic factors affecting military maritime activities in area

Users:

- DND, AES and civil users

Data Acquisition: on real time basis in accordance with World Meteorological Organization standards

- major weather data sources: AES and world meteorological networks.
- weather data from offshore DND patrols on real time basis,and by debriefing after mission completion.
- controlled sub-surface data from DND ships and aircraft.
- certain data from AES sensor systems on ships and buoys.
- data from U.S. Department of Defense sources.
- sea state data from certain OAS wave stations.
- satellite data by photofacsimile from AES.

Data Handling, Processing and Retrieval:

- at CF METOC Centre Halifax, manually and by ADP techniques utilizing a dedicated minicomputer; at CF METOC Centre Esquimalt, manually.
- processes meteorological and oceanographic products on a real time basis.
- meteorological and selected oceanographic information is disseminated to users over AES and DND communication systems including dedicated DND radio broadcasts.

Parameters

Inputs:

- meteorological and oceanographic data on weather, ice conditions, sea surface and sub-surface conditions

Outputs:

- processed meteorological and oceanographic information to DND and NATO.
- selected data and products, including sea surface temperature analyses and sea state analyses and forecasts, to AES and civil users.

Remarks

Centres are:

a. financed and administered by DND.

b. staffed by professional meteorologists seconded from AES, and by CF meteorological technicians; these personnel are appropriately cross-trained in military oceanography.

c. fully linked into the AES communication system.

OCEAN MANAGEMENT FUNCTION: Ocean Service Activities

APPLICATION: Ice reports and forecasts - support of all ocean management activities

I SURVEILLANCE REQUIREMENTS

DEPARTMENTS: DOE (AES) provides services in cooperation with DOT; all departments involved in ocean management activities are users.

SURVEILLANCE INFORMATION REQUIRED:

- Ice reports, forecasts and charts require information on:
  - extent of ice coverage
  - type, age and thickness of ice
  - ice movement and pressure
  - distribution and height of ridges
  - snow cover
  - location, extent and size of leads
  - location and drift of icebergs, bergy bits and growlers
  - location and size of polynias
- There are three distinct requirements for ice information:
  1. Planning: for pre-season planning of ship utilization, marine insurance, hull design, regulatory policy, etc. Ice data is of a statistical and time series nature, and is derived from the strategic data base.
  2. Strategic: for short-term planning for voyages and ice forecasting. AES: 3 days/week coverage in all areas is needed. *(Original requirement to Task Force: daily coverage in all areas)*
  3. Tactical: for immediate support of a single ship or group of ships travelling together. Ice data within immediate ship area is required with minimum delay on a continuous or nearly continuous basis.

SURVEILLANCE TARGETS:

- Ice, ridges, snow cover (especially wet snow), leads, icebergs, bergy bits, growlers, polynias.

SURVEILLANCE INFORMATION SPECIFICATIONS:

1. GEOGRAPHICAL AREAS OF INTEREST:

Present:

- Canadian Arctic; Labrador Sea north of 55°N; Gulf of St. Lawrence and Eastern Seaboard (including Newfoundland waters); Great Lakes and St. Lawrence Seaway; Grand Banks and eastern approaches.
- DOT: In Canadian Arctic information required for present operational purposes from June 1 to Nov. 30 and for long range planning on a year round basis. Information for other areas is required throughout the ice formation period from Dec. 1 to June 30 (Labrador Coast).
- In the Arctic and off Labrador detailed ice information is required in support of offshore drilling which takes place during the "open" water season.
- Predictions of ice movement and of ice pressure are particularly important for extended season drilling operations in the Beaufort Sea where southerly movements of the polar pack can require drilling operations to be halted.
- Requirements for ice information are particularly stringent for marine traffic routes.

Future:

- Major hydrocarbon finds in the Beaufort Sea or Labrador Sea and the introduction of icebreaking LNG and oil tanker operations to the Arctic will mean significantly increased ice information requirements. DOT: a large scale systematic program of Arctic sea ice investigation will eventually be required.
- DOT: Projected Arctic developments will require operational data for planning, strategic and tactical purposes throughout the winter months.
- DOT: Historical data on Arctic winter conditions is sparse and will have to be developed as planning for the construction of a nuclear icebreaker proceeds.
- DOT: Further operations research techniques for developing investment strategies for icebreaking capacity will require access to extensive statistical data on ice conditions.

2. ACCURACY:

Requirement:

		)	These figures indicate AES
- Planning:	10-20 km	)	requirements for both posi-
- Strategic:	500 m	)	tional accuracy and resolu-
- Tactical:	500 m	)	tion and DOT requirements
		)	for horizontal accuracy.

- Resolution for tactical purposes is required by AES only within the immediate area of ships (20 km).

- DND requirements are the following:

	lead detection	route identification
locational accuracy	1 n.m.	0.25 n.m.
spatial resolution	15 m.	25 m.
thermal	2°C	0.5°C (full ice cover) 2°C (partial ice cover)

Present Situation:

- DOT: At present time, little or no information is provided on ice thickness, which can vary in field ice from a few inches to 7-8 feet and in multi-year ice and pressure ridges from 6 feet to 30-40 feet.

3. FREQUENCY OF OBSERVATION:

- Planning: twice weekly (AES: once per week if complete coverage required.)

- Strategic: daily (AES: 3-4 times per week.)

- Tactical: continuous or nearly continuous (AES: at least once a day.)

- AES requires real time or near real time delivery of data to Ice Central and all weather and night data acquisition.

Present Situation:

- N.A.

- DND indicates that continuous coverage for tactical information is possible but is also constrained by requirements for crew rest and helicopter maintenance.

4. RESPONSE TIME:

Requirement:

- Strategic: 6-24 hours
- Tactical: Immediate

Present Situation:

- DOT: Strategic: 6-24 hours
  Tactical: 1-6 hours

SURVEILLANCE DATA ACQUISITION:

Present:

- Ice Central in Ottawa, an AES Special Function Centre, receives ice surveillance information from various sources for preparation of forecasts and other information products. See following system description.

Possible Future Developments:

- Cabinet has approved Crown procurement of two DASH 7R's, suitably modified for ice reconnaissance. A joint DOT/DOE Treasury Board submission is expected in early to mid 1979.
- Use of satellite Synthetic Aperture Radar for all-weather ice observations is under investigation in the SURSAT Program. Results as of early 1979 are encouraging.
- DFO/OAS is exploring the possibility of establishing an Ice Research Centre to assist in improving capabilities to predict ice growth, distribution and movement (on time scales ranging from hours to seasons).

SURVEILLANCE DATA HANDLING/PROCESSING:

Present:

- See following description of Ice Central.

Possible Future Developments:

- DND suggests that a digital facsimile capability will be available in the 1980's.

- Other sources of pictorial imagery would be low light level television, SLAR, SAR, and surface radar. (Presently, while SLAR is operational on one of the AES ice reconnaissance aircraft, SLAR imagery is not sent directly to vessels and other users.)

II INFORMATION SYSTEMS - REAL TIME

Function: SERVICES: Ice Forecasting

Basis in Law: Cabinet and Treasury Board Directives

Department: DOE/AES

System

ICE CENTRAL (AES Special Function Centre)

Purpose: to acquire, collect, archive basic ice data.

- to analyse, describe and predict ice conditions in navigable waters
- to disseminate current and predicted ice information to the general public and to special users.
- to provide historical ice data and information.

Users:

- general public, shipping, fishing industry, other users on real time basis.
- Ice Central outputs are primary inputs in other ocean information systems (e.g. VTM, ECAREG, Search and Rescue).

Data Acquisition

- contract with Nordair for 2 aircraft dedicated to ice reconnaissance
- observations from other vessels and aircraft, including DND patrols.
- specially enhanced HRPT imagery from NOAA satellites, relayed to Ice Central from Satellite Data Laboratory (Downsview) and Arctic Weather Centre (Edmonton); LANDSAT imagery from ISIS.
- information from U.S. Coast Guard International Ice Patrol in northwest Atlantic.

Data Handling, Processing, Retrieval

- Ice Central, as an AES Special Function Centre, is fully linked to the overall AES system and thus to the Global Observing System, Global Telecommunications System and Global Data Processing System
- ice reconnaissance aircraft inputs to Ice Central via facsimile.
- satellite imagery from Downsview and Edmonton to Ice Central by photo facsimile; Landsat imagery from Prince Albert via ISIS and facsimile; Ice Central has no direct satellite read-out capability
- Ice Central output to user network by standard communications means, including facsimile.
- properly equipped users can, within range, receive reconnaissance information directly from aircraft.

Parameters

Inputs: ice-concentration, age, snow cover, surface features, movement, water features (e.g. leads)

- high resolution meterological satellite imagery from Satellite Data Laboratory and Arctic Weather Centre, Landsat imagery from ISIS.

Outputs: daily ice forecasts, thirty-day forecasts, seasonal outlooks, composite ice charts, present conditions, special small area forecasts, ice summaries, special ice forecast services on a cost recovery basis.

- ice advisories, forecasts and ice charts issued by Ice Central daily by radio and radio facsimile.

Remarks

- direct Ice Central link may be established with computers in Satellite Data Laboratory (Downsview) for analysis of satellite imagery.
- improvements in communication of ice reconnaissance data/information to Ice Central from observation platforms, and to users from Ice Central or directly from platforms, are required.

III INFORMATION SYSTEMS - ARCHIVAL

Ice information, including in particular Ice Central input and output information, is archived by the AES Ice Climatology and Application Division.

The Polar Continental Shelf Project also archives ice information.

OCEAN MANAGEMENT FUNCTION: Ocean Service Activities

APPLICATION: Search and Rescue (SAR)

I SURVEILLANCE REQUIREMENTS

DEPARTMENTS: DOT/CCG (lead agency for marine SAR), DND, DFO

SURVEILLANCE INFORMATION REQUIRED:

- Detection, identification, position and status of any vehicle and/or crew in distress, including lifeboats and rafts.

- Identification of shipping or other activity in the distress area which may render assistance.

SURVEILLANCE TARGETS:

- Vessels 20-30 metres or larger, dead in water, listing severely or on fire.

- Clusters of or isolated single lifeboats or life rafts, 3 metres or larger, in relatively isolated locations. These are often made of materials which radar does not 'see', such as fiberglass, wood, rubber, etc.

- Downed aircraft and vessels in distress

- Vessels in distress and downed aircraft may be equipped with emergency transmitters (EPIRB's, ELT's) which emit VHF or UHF signals on distress frequencies.

- Currently, submersible and underwater craft/installations are not of particular SAR concern. This presumably could change when offshore oil and gas activities approach the production phase. Submersibles would normally have a mother ship; submarines and fixed installations would normally have radio transmitter buoys. Radar reflectors could perhaps be developed as distress indicators for underwater vehicles and installations.

SURVEILLANCE INFORMATION SPECIFICATIONS:

1. GEOGRAPHICAL AREAS OF INTEREST:

Present: -Sector to North Pole from 30°W to 141°W at 40°N off east coast and 49°N off west coast. SAR requirements cover all this area at all times, even if the number of distress incidents historically drops during a certain season. (See attached map of SAR regions.)

Future: -Growth in northern shipping, fishing and hydrocarbon development activities will lead to increased SAR requirements. Hostile climate will have implications for response time and SAR resource deployment.

2. ACCURACY:

Requirement:

- Location: 20 km for detection and 3 km for identification. DFO suggests, however, that the detection requirement should, if possible, be 10 km; 20 km would result in waste of time and resources through rescue craft having to perform circular search over an area of 1200 sq. kms.

- Spatial resolution: 2 metres (without radar reflectors)

- Temperature: 2°C for detection and .25°C for identification. Temperature determination may be an important factor in terms of survival time in the water but it is not absolutely essential for SAR application.

Present Situation:

- N.A.

3. FREQUENCY OF OBSERVATION:

Requirement:

- 3-4 hours. *(Original requirement to Task Force: 12 to 24 hours.)* Once a vessel or crew in distress has been identified, hourly to continuous coverage is desirable until rescue vehicle arrives on the scene.

Present Situation

- Dependant on location of SAR incident and availability of SAR resources.

4. RESPONSE TIME:

Requirement:

- As soon as possible but not more than 4 hours. *(Original requirement to Task Force: not more than 6 hours.)*

Present Situation:

- 10-20 hours: from aircraft downed to time RCC alerted.

- less than 30 minutes (2 hours outside working hours): from time RCC alerted to time SAR vessel or aircraft is actually en route.

- less than 4 hours (41% of 1976 cases) to more than 12 hours (44% of 1976 cases): from time RCC alerted to time downed aircraft is found. The mean time between RCC alert and arrival of assistance for 1976 cases of downed aircraft was 28 hours without ELT in operation at crash site and 2.5 hours with such ELT operation.

- There is a seasonal variation in SAR response time because search and location are more difficult during winter months.

SURVEILLANCE DATA ACQUISITION

Present:

- see SAR system description which follows.

Possible Future Developments:

- In general, there will be a need for an improved capability for more real time detection, location and identification of distress vessels in order to reduce the time from onset of the distress incident to actual rescue.

- Canada is now participating with the U.S. and France in the experimental SARSAT program, with feasibility testing of 1 satellite and 2 ground stations scheduled for 1982. An operational SARSAT system of 3 satellites would provide coverage every 4 hours. A satellite detection system would have a capability for ELT and EPIRB signal detectors.

- R&D is now underway on improved reliability of ELT's and EPIRB's, including a suitable replacement for the ELT's lithium based battery. Plans for R&D on a new generation ELT to meet the requirements of an operational SARSAT program are being examined.

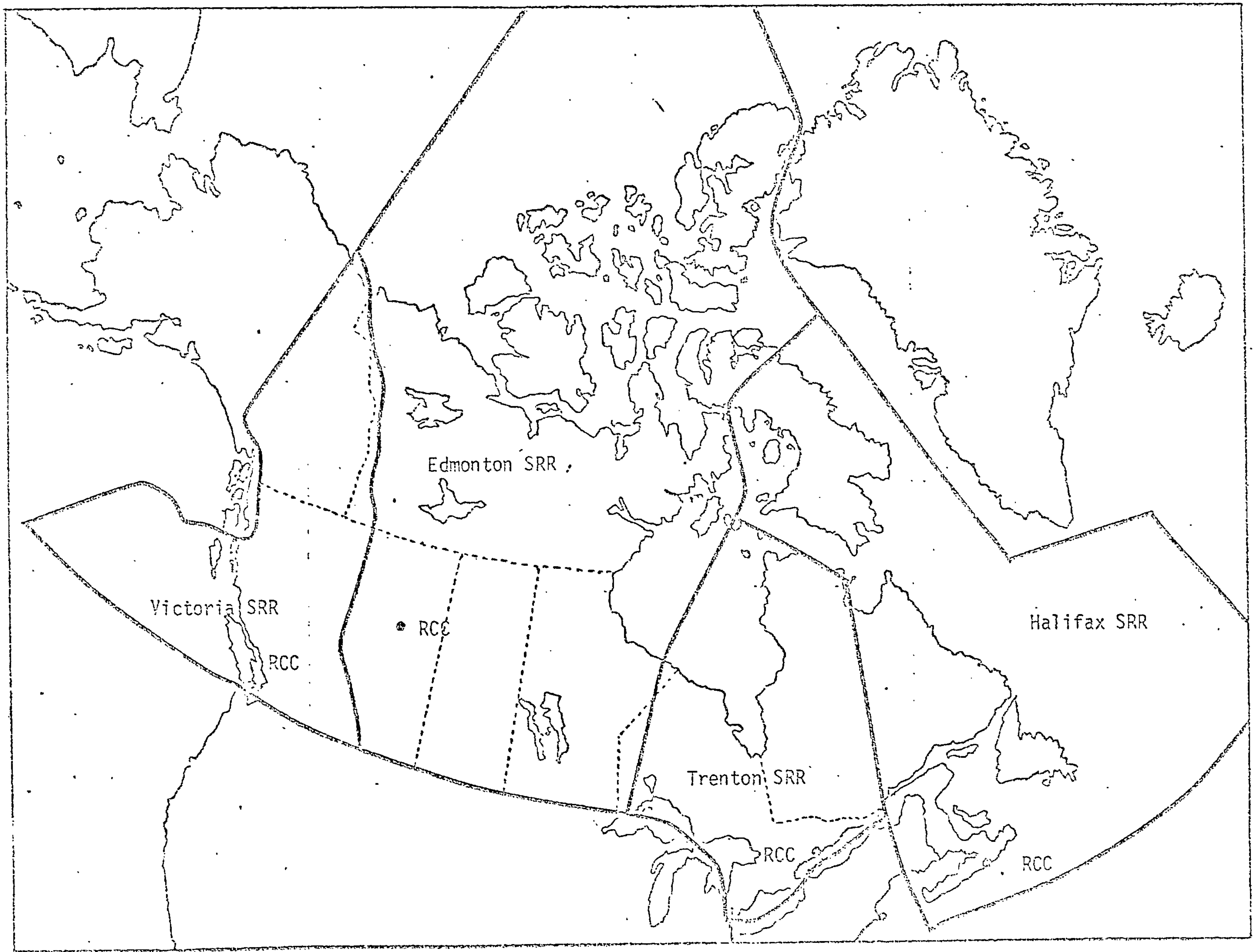
- DOT is conducting feasibility studies on fitting ships, lifeboats and life rafts with EPIRB's. Plans to require broader use of a new generation EPIRB aboard vessels are presently being examined. The more extensive use of radar reflectors and infrared transmission is also being studied.

- Future developments in vessel traffic monitoring and ice, weather and sea state forecasting will have impact on SAR.

SURVEILLANCE DATA HANDLING/PROCESSING:

- SAR data and direction of response to SAR incidents handled by Rescue Coordination Centres (RCC's). See SAR system description which follows.

CANADIAN SEARCH AND RESCUE REGIONS



II INFORMATION SYSTEMS - ARCHIVAL

Function: Service: Search and Rescue (SAR)

Basis in Law: Cabinet Directives

Department: DND, DOT/CCG; DOT is lead agency for marine SAR

System

Purpose:

- to protect the safety of life and property in all Canadian waters and high sea areas.

Users:

- DOT, DND are agencies responsible for SAR missions; those in distress at sea are "users" in the sense of being recipients of SAR service.

Data Acquisition:

- any information from any source on occurrence, location, detection of incidents requiring SAR response is communicated to Rescue Coordination Centres (RCC's) through DOT marine communications network and/or other communications facilities as required.
- aircraft and some vessels are required to carry emergency transmitters (ELT's for aircraft, EPIRB's for vessels, more sophisticated position locators on commercial aircraft) which emit VHF or UHF signals on distress frequencies for locating craft in distress
- DOT owns and operates vessels of varying size and capability (from lifeboats to vessels over 100 feet long) fully dedicated to SAR, located as follows: East Coast-17, Great Lakes-13, West Coast-17.
- several government vessels from various departments are tasked as secondary SAR vessels; all vessels, government and civilian, are required by international law to assist in emergencies in their vicinity.
- DND operates aircraft and helicopter squadrons as primary SAR units at Comox, Edmonton, Trenton, Gander, Summerside; these units available for marine SAR as necessary.
- RCC's have ready access to VTM, ECAREG and other marine traffic information for the purpose of identifying marine traffic in and around a distress area; in addition, RCC's have a linkage with the U.S. AMVER (Automated Mutual Assistance Vessel Rescue) System to assist in locating missing vessels and to identify possible rescue vessels in a distress area.

Parameters

Input:

- VTM, ECAREG information; sea state, weather, ice information, ELT-EPIRB transmissions.
- reports from ships via CCG communications network.

Outputs:

- (from RCC's): broadcast of input information as necessary; tasking of SAR vessel and aircraft response.

Remarks

Anticipated System Requirements:

- improved capabilities for real time detection, location and identification of vessels in distress; objective is to increase survival by reducing the time between onset of distress incident and rescue.
- improved real time information on location and identification of shipping and aircraft which might assist in SAR incident.
- improved reliability of ELT's. EPIRB's; required R&D now underway.
- developments in vessel traffic management and ice, weather, sea state forecasting will have impact on SAR.
- action is now being undertaken to transfer Arctic Marine SAR coordination responsibility from Edmonton which has no CCG marine staff to the Victoria RCC which has CCG Rescue Officers and a Marine Watchkeeper establishment.

Cont'd

Function: Service: Search and Rescue (SAR)

Basis in Law: Cabinet Directives

Department: DND, DOT/CCG; DOT is lead agency for marine SAR

System	Parameters	Remarks
Data Handling, Processing and Retrieval:		
- SAR incidents are handled through RCC's (Rescue Coordination Centres) co-located with DND facilities in Halifax, Trenton, Esquimault, Edmonton.		
- all necessary input information and tasking of SAR vessels and aircraft handled through RCC's;		
- all RCC's have telex, telephone, automatic data interchange system, and communication equipment and facilities with access to CCG radio stations and other DOT and DND communication systems; in addition, RCC Victoria has a full-time dedicated communication link (hot line circuit) with all CCG Radio Systems, Traffic Centres, Lifeboat Stations, District Offices and Regional Manager SAR, thus allowing direct RCC communication with search units; a similar communication system is now being established for Eastern Canada.		
- RCC's are not computerized operations as such although they have access to systems such as ECAREG if necessary.		
- emergency location transmitters (ELT, EPIRB) monitored continuously in areas around major airport listening stations; limited monitoring by civilian and military aircraft in flight.		
- SAR incidents recorded by RCC regions in 1977: Esquimault -- 2,830 marine, 512 air; Edmonton (includes western Arctic) -- 20 marine, 563 air; Trenton (includes Great Lakes, eastern Hudson Bay) -- 829 marine, 526 air; Halifax -- 897 marine, 569 air.		

III INFORMATION SYSTEMS - ARCHIVAL

SAR Database - A new computerized SAR database has recently been established. It contains the history of all SAR incidents in the last 3 years and up-to-date pertinent statistical information. It will be a planning tool for future SAR activities. Access will be through appropriate DND and DOT/CCG offices, although access to classified material may be restricted.

OCEAN MANAGEMENT FUNCTION: Ocean Service Activities

APPLICATION: Cartography, hydrography, oceanographic surveys, marine geoscience surveys

NOTE: This application has been expanded considerably. The Surveillance Satellite Task Force Report had considered only cartography because of the more obvious applicability of satellite surveillance techniques. Hydrography and oceanographic and marine geoscience surveys have been included here because they represent significant ocean information requirements.

I SURVEILLANCE REQUIREMENTS

DEPARTMENTS:
Cartography - EMR (lead agency), DND, DFO
Hydrography - DFO (lead agency); several other departments have requirements
Oceanographic and marine geoscience surveys - EMR, DFO, DND

SURVEILLANCE INFORMATION REQUIRED:

- Cartography, hydrography: Current, accurate, large scale mapping and charting of Canadian Arctic and remote coastal regions for purposes of resource exploration and exploitation, transportation routes or facilities and military installations. Cartographic quality imagery is required.

- Oceanographic surveys: various physical, chemical and biological oceanographic parameters are required at the surface, in the water column and near the sea bed.

- Marine geophysical surveys: geological samples; gravity, magnetic, seismic data.

SURVEILLANCE TARGETS:

- Cartography: Land and coastline features.

- Oceanography: Physical, chemical and biological characteristics of areas of interest because of activities related to the exploitation of renewable and non renewable resources, environmental sensitivity or vessel traffic utilization.

SURVEILLANCE INFORMATION SPECIFICATIONS:

1. GEOGRAPHICAL AREAS OF INTEREST:

Present and Future:

- Cartography: Canadian Arctic and remote coastal regions. DND informs EMR of its regional priorities (classified material).

- Hydrography: It is not realistic to forecast exact regional priorities for hydrography over the next decade because resource development and charting priorities fluctuate. However, it can be said that there will be increasing priority in the Arctic and Labrador areas, expecially the routes likely to be used by deep draft vessels.

- To a considerable degree, the above statement on hydrographic requirements applies to oceanographic and geoscience surveys. However, a certain core of these survey activities are for the purpose of basic research and would tend to be less closely tied to resource development and transportation.

2. ACCURACY:

Requirement:

- Cartography: Resolutions required for routine cartography are 6 m. vertical and 4 m. horizontal for coarse detail and 2 m. vertical and 1 m. horizontal for fine detail. For normal cartography uses, location of plot that has been imaged to about 4 km is adequate because, if plot is used, ground party would survey in locator points.

- Cartography: additional statement from DPW: - Requirement is for location of the land/sea interface to within 0.3 m to monitor changes resulting from natural or man-made causes such as storms or structures. The area of interest would be all coastal waters, including the large inland lakes, monitored on a daily, weekly, monthly, yearly, or tidal basis.

- Oceanography: Certain programs require very high resolution and accuracy in the measurements which can only be realized by careful in situ measurements as opposed to, say, measurements by remote sensing techniques. Other programs will require less precise data. It should be noted that much of the oceanographic data collected can be thought of as being "multi-tasked" in that it is used for purposes in addition to the primary purpose for which it was collected. In this case an application other than the primary one could determine the precision to which the data is collected.

Present Situation:

- N.A.

3. FREQUENCY OF OBSERVATION:

- Hydrography: As required. However, if a library of past satellite imagery exists, this would likely meet the charting requirement. In fact, in the detection of isolated rocks and shoals, several separate passes may be necessary to differentiate between them and ice.

- Oceanography: As required for most programs. However, certain data are to be reported to international systems within 24 hours of the taking of the observation. Certain data are to be processed and disseminated to managers of national and international experiments within one or two weeks of the data being taken. Some wave and buoy measurements are reported in real time to AES systems.

- Others: N.A.

4. RESPONSE TIME:

Requirement:

- Cartography: one week to one month.

Present Situation:

- N.A.

SURVEILLANCE DATA ACQUISITION:

Present:

- Cartography: N.A.

- Hydrography: see following system description. In addition, aerial hydrography is in regular use and LANDSAT imagery has been used where no air photos exist.

- Oceanographic surveys: see following system description.

- Marine geophysical surveys: generally carried out, using a wide variety of techniques, in conjunction with oceanographic cruises.

- Oceanography: Ships buoys, aircraft and satellites are used. Ships of opportunity are also used. International data exchange both in real time and of an archival nature play a major role in data acquisition. Of the order of 50% of the temperature, salinity, chemical and nutrient data in MEDS is acquired by international exchange. International exchanges occur as a result of bilateral agreements and because Canada can and does on occasion require foreign research vessels to submit the data gathered while operating in Canadian waters.

Possible Future Developments:

- Cartography: Required resolutions for routine cartography exceeds the probable capabilities of a surveillance satellite. However, for urgent strategic and tactical needs in areas for which there are no large-scale maps or where existing maps contain gross errors, radar and MSS imagery would be very useful for construction of working maps and charts, with the exception of height data that may not be sufficiently precise.

- Hydrography: An aerial hydrography project is in hand which will use colour film selected to obtain maximum penetration. This may be coupled with an inertial guidance system to position rocks and shoals where conventional aerial triangulation cannot be used. It is also planned to add a laser system to provide ground truthing. System is to be tested in Thousand Islands area during summer of 1979. If successful, system will have considerable effect as the hydrographer on an inshore survey would have a very detailed plot, including shallow water contours.

- Oceanography: Future developments will depend to a large extent on a combination of shipborne and remote sensor development and on offshore resource developments.

SURVEILLANCE DATA HANDLING/PROCESSING:

- Cartography: Data format is rectilinearized imagery with latitude and longitude annotation. The capacity to extract heights from imagery or from special sensors such as a radar altimeter is required.

- Oceanography: Data is processed in a variety of laboratory and centralized facilities mainly via computers. Data is telecommunicated to and from both coasts and central facilities in both AES and OAS headquarters as required to fulfill OAS responsibilities. See also following system descriptions.

- Others: see following system descriptions.

II INFORMATION SYSTEMS - REAL TIME AND ARCHIVAL

Marine Geoscience Surveys - EMR's Atlantic Geoscience Centre (AGC) at the Bedford Institute of Oceanography and Pacific Geoscience Centre (PGC) at the Institute of Ocean Sciences carry on various geoscience research and survey programs, perform off-shore terrain evaluation, and conduct mapping in support of off-shore mineral resource determination.

Data is usually acquired during cruises on Bedford Institute and Institute of Ocean Science vessels, and also through exchanges with other institutions.

Input paramters of concern include: digital recordings of bathymetry, gravity and magnetics; chart records of seismics and sidescan sonar; geological samples from coring and dredging; bottom photographs and cruise records; data from geological sample analyses; working maps and charts. Analysis of this data provides information of use in various research programs and for resource and geological survey purposes.

AGC and PGC maintain data in archives, both in the form of standard files and, increasingly, in computerized data banks.

Hydrography, oceanographic surveys - The following system description is an integrated summary of the various oceanographic, hydrographic and related data service systems operated by DFO/Ocean and Aquatic Sciences.

Oceanography: - Physical, chemical and biological data is stored in a variety of archival systems, both regional and national and can be retrieved by a variety of procedures in various formats for dissemination to users. The Bedford Institute, The Institute of Ocean Sciences in Patricia Bay and the Marine Environmental Data Service in Ottawa all have major holdings of oceanographic data. The regional archives overlap in some areas with MEDS archives, but generally speaking there are significant regional data banks not held in Ottawa, such as the current meter data files held on both coasts.

A real time system (REDSS, for Real time Data Services System) is operated by the Marine Environmental Data Service for support to the Flemish Cap International Experiment, the First GARP Global Experiment and for some national requirements such as the control of Great Lakes water levels and the planning of oceanographic cruises.

The other real time system is the tsunami warning system. The Canadian system of gauges is operated on the West Coast and feeds and receives information from the International Tsunami Warning Center in Hawaii.

II INFORMATION SYSTEMS - REAL TIME AND ARCHIVAL

Function: Services: hydrography, oceanographic research and surveys, data services in support of marine operations

Basis in Law: Hydrography: Order in Council P.C. 461, 1904; Canada Shipping Act, Resources and Technical Surveys Act

Department: DFO / Ocean and Aquatic Sciences (OAS)

System

Systems Operated by OAS:
1. OAS Research Program
2. National Water Level Gauging System
3. Wave Climate Study
4. Canadian IGOSS Participation
5. Hydrographic Surveys
6. Support to International Oceanographic Experiments
7. Other

Purpose:
- All Systems - to support OAS oceanography research program; to provide adequate marine data services to meet national and international needs; to provide scientific information on the marine environment.

5. Hydrographic Surveys - to produce navigation, resource and recreational charts and maps of coastal, offshore and inland navigable water.

Users:

- DFO, other government departments (e.g. DND METOC centres for wave forecasting, DPW for construction of marine structures); universities; Integrated Global Ocean Station System (IGOSS) for temperature - salinity profiles; scientists conducting oceanographic experiments, private industry for marine operations design and construction.

Data Acquisition:

1. OAS Research Program - 11 major ships, 230 smaller ships and launches; variety of sensors and techniques used for measurement of wide range of oceanographic parameters.

2. National Water Level Gauging System:

about 140 permanent water level gauging stations in navigable waters in and around Canada; temporary gauges set up as needed to support hydrographic surveys or scientific experiments; gauges installed by Canadian Hydrographic Service (CHS) of OAS.

3. Wave Climate Study - measured wave data from 20 sites (3 long term, others change each year); 20 minute recording taken at each site every 3 hours; all oil rigs and drill ships operating off East Coast and in Arctic since 1971 have carried wave buoys to obtain offshore measurements; operated by Marine Environmental Data Services (MEDS) of OAS.

Parameters

Inputs:

1. OAS Research Program - data on wide variety of oceanographic parameters such as temperature, conductivity, salinity, depth, surface and underwater currents, sea-air interface temperature, and so on.

2. National Water Level Gauging System

   - tide and water levels

3. Wave Climate Study

   - wave heights and periods.

4. Canadian IGOSS Participation

   - temperature-salinity profiles, certain pollutants.

5. Hydrographic Surveys

   - depth soundings (both spot and continuous); location of obstacles, shoals, structures, shore line, etc; various geophysical parameters (seismic, gravity, magnetic)
   - all input parameters fixed precisely by location.

6. Support to International Oceanographic Experiments

   - temperature - salinity profiles for Flemish Cap experiment.

7. Other

   - CODS: sea state, air and sea surface temperature, winds, barometric pressure.
   - EAMES: sea state, ice, biological activity, other environmental data pertinent to eastern Arctic offshore drilling.

Outputs:

1. OAS Research Program -

   various information products of oceanographic interest.

2. National Water Level Gauging System

   tide and water level reports and predictions.

Remarks

Anticipated System Development:

5. Hydrographic Surveys - development of through-ice depth sounding techniques; development of aerial survey techniques involving stereo photography and/or laser radar; increased automatic data logging in digital form; increased computerized automatic chart production using digitized compiled information.

6. Support to International Oceanographic Experiments -

   FFGE: position and sea surface temperature readings to be transmitted by satellite to MEDS from up to 350 drifting buoys for use in real time ground truthing of satellite observations.

7. Other - CODS: An R & D Program; emphasis is shifting to development and operations with reduced support to pure R & D.

Anticipated System Requirements:

(all systems except hydrography)

MEDS Archives - if provisions of Oil and Gas Act require publication of oil company data for area of EMR responsibility, MEDS data archiving capability may be strained.

cont'd

Function: Services: hydrography, oceanographic research and surveys, data services in support of marine operations

Basis in Law: Hydrography: Order in Council P.C. 461, 1904; Canada Shipping Act, Resources and Technical Surveys Act

Department: DFO / Ocean and Aquatic Sciences (OAS)

System	Parameters	Remarks
Data Acquisition (Cont'd)	Outputs (Cont'd)	
4. Canadian IGOSS Participation - research vessels report up to four times daily to Global Telecommunications Systems (GTS) on temperature-salinity profile measurements.	3. Wave Climate Study wave and sea state reports. 4. Canadian IGOSS Participation temperature salinity profiles to IGOSS network.	
5. Hydrographic Surveys - depth soundings and other charting parameters obtained by OAS research and hydrographic fleet and under certain circumstances by helicopter, hovercraft or tracked vehicles; various geophysical parameters (seismic, gravity, magnetic) obtained from same vessels in co-operation with both Geological Survey and Earth Physics Branch of EMR; hydrographic and other survey data also obtained by contract with private survey companies; DOT ice-breakers used as hydrographic survey platforms during the course of ice-breaking operations.	5. Hydrographic Surveys navigation, resource and recreation charts and maps; CHS produces per year approximately 20 new charts, 100-200 new editions of old charts and 100-200 reprints of old charts showing critical new information which is released initially in Notices to Mariners.	
6. Support to International Oceanographic Experiments - Flemish Cap Experiment: temperature-salinity profiles obtained by research vessels	6. Support to International Oceanographic Experiments Flemish Cap Experiment: various data products in near real time for use in determining further data acquisition; long term information of applicability to Flemish Cap fisheries.	
7. Other - (a) Canadian Ocean Data System (CODS): data from experimental data buoy program processed by Hermes Electronics and made available to MEDS. (b) Satellite imagery used for various research purposes. (c) EAMES data from DIAND archived at MEDS.		
Data Handling, Processing and Retrieval:		
All systems (except hydrographic surveys), - Data Archival (MEDS) - data from all OAS systems except hydrographic surveys archived in large central data banks at MEDS headquarters; also included is data collected by Canadian universities and by other countries in Canadian areas of interest.		
- some data archived in regional institutes in St. John's, Halifax, Vancouver-Victoria; data transferred to central bank when of sufficient volume of reliable quality; regions can access central bank by low speed communications lines, although much data is transferred by manual means,		
- central data bank holdings consist of few billion characters of data in several data bases including: Oceans Data Base (Nansen Bottle File --130 million characters; Canadian MBT (mechanical bathythermograph) - 110 million characters; Foreign MBT--240 million characters; CTD (conductivity, temperature, depth) -- 45 million characters), Tides and Water Levels Data Base -- about 250 million characters; Waves Data Base -- 800 magnetic tapes.		
- data can be retrieved by several criteria: area (latitude and longitude), cruise number, station number in cruise, country, year, month, day institute, ship, range of dates, sounding information (e.g. deep or shallow), distance of last sounding from bottom, presence of certain parameters by depth, type of instrument.		

cont'd

Function: Services: hydrography, oceanographic research and surveys, data services in support of marine operations

Basis in Law: Hydrography: Order in Council P.C. 461, 1904; Canada Shipping Act, Resources and Technical Surveys Act

Department: DFO / Ocean and Aquatic Sciences (OAS)

System	Parameters	Remarks
Data Processing and Retrieval (Cont'd) 4. Canadian IGOSS Participation - data reported up to 4 times daily to Coast Guard radio stations and subsequent insertion on Global Telecommunications System. 5. Hydrographic Surveys - survey data plotted on field sheets; critical findings broadcast immediately in Notices to Mariners data stored on field sheets and not in computerized data banks; production of charts has not generally been a computerized process, but CHS gradually compiling file of digitized compiled information for computer controlled automatic chart production. 6. Support to International Oceanographic Experiments data for Flemish Cap experiment reported to DND METOC centres and subsequently inserted on GTS.		

Non-Ocean Management Applications

OCEAN MANAGEMENT FUNCTION: NOT APPLICABLE

APPLICATION: Flood control

I SURVEILLANCE REQUIREMENTS

DEPARTMENT: DOT

SURVEILLANCE INFORMATION REQUIRED:

- Ice coverage and form on rivers, especially the St. Lawrence River.

SURVEILLANCE TARGETS:

- Extent of ice coverage, ice movement and ice jams on rivers where flood control is desirable, especially the St. Lawrence River.

SURVEILLANCE INFORMATION SPECIFICATIONS:

1. GEOGRAPHICAL AREAS OF INTEREST:

   - Along all major rivers (especially the St. Lawrence) where ice jams could take place and could cause flood damage.

   - In 1985-2000 time frame, flood control requirements may apply in remote areas like Hudson Bay, Baffin Island.

2. ACCURACY:

   Requirements:

   - Location of actual or potential ice jams

   Presently Obtained:

   - N.A.

3. FREQUENCY OF OBSERVATION:

   Requirements:

   - In major industrial or urban areas or along major waterways such as the St. Lawrence Seaway, almost continuous coverage is required at certain times, such as the spring break-up.

   Presently Obtained:

   - N.A.

4. <u>RESPONSE TIME</u>:

<u>Requirement:</u>

- 4 hours maximum

<u>Presently Obtained</u>:

- N.A.

<u>SURVEILLANCE DATA ACQUISITION</u>:

- Surveillance is carried out from aircraft (including occasional DOT charter of private air photo services) and land-based observers.
- Satellite surveillance may be most cost-effective means of obtaining data for eventual flood control surveillance in remote areas.

<u>SURVEILLANCE DATA HANDLING/PROCESSING</u>:

- No special requirements.

OCEAN MANAGEMENT FUNCTION: NOT APPLICABLE

APPLICATION: Forest resource management (in areas under DIAND jurisdiction)

I SURVEILLANCE REQUIREMENTS

DEPARTMENTS: DIAND, DOE (Canadian Forestry Service)

SURVEILLANCE INFORMATION REQUIRED:

- Composition of forest stands by areas, species and volumes.
- Location and size of fires, fuel situation, losses by area, species and volume.

SURVEILLANCE TARGETS:

- Areas of forest stands by species; volume of timber in stand. Classify immature, mature and over mature stands, standing dead timber, cut over debris, old burn and tree survival within burned areas. Recognize smoke, active fires; determine size, intensity, perimeter of fires; measure unburned fuels.
- Classification as to species, age and condition may be possible from spectral signatures.
- Location of harvesting, fuel loading, regeneration potential.
- Location, size and extent of insect and disease outbreaks.

SURVEILLANCE INFORMATION SPECIFICATIONS:

1. GEOGRAPHICAL AREAS OF INTEREST:
   - All forest areas in the Yukon and Northwest Territories.
2. ACCURACY:

   Requirements:
   - "High" accuracy for location and for area and volume estimates (DOE indicates 40 m x 4 m adequate).
   - Accuracy of 10 m x 10 m for forest fires.

   Presently Obtained:
   - N.A.

3. FREQUENCY OF OBSERVATION:

Requirements:

- Resource management: bi-monthly
- Forest fire detection and assessment: daily or more frequently.

Presently Obtained:

- Photography coverage is once every 5-20 years

4. RESPONSE TIME:

Requirements:

- Resource management: 10 days to 1 month
- Forest fires: 1 to 2 hours

Presently Obtained:

- Resource management: present LANDSAT coverage adequate.

SURVEILLANCE DATA ACQUISITION:

- Forest resources presently being measured by low-level aerial photography.
- Location and size of fires are now being obtained from forestry observation towers, charter aircraft and helicopters. Aerial photography is used.

SURVEILLANCE DATA HANDLING/PROCESSING:

- Format: standard photographic imagery
- Notification of forest fires is made to the nearest forestry observation tower or to any other territorial forestry officer.
- DOE indicates desirability of single central site with notification given to respective fire district in case of fires.
-

COMMENTS:

- Determination of volume may not be possible from satellite imagery. Research being done on spectral signatures may prove fruitful for classification. Infrared and/or multi-spectral sensors should be able to detect forest fires, but not through cloud. DOE, DIAND involved in remote sensing research.

- DOE: Most forestry related requirements can be satisfied by archival data, namely classification of vegetation types, monitoring harvesting patterns and extent, assessment of fire-fuel loading and fire spread potential, road construction, etc. Real time data is essential for detection and monitoring of forest fires, assessing impact of major land based activities, forecasting fire hazard, etc.

NOTE: - DOE summary: (1) LANDSAT meets most of the vegetation mapping and forest resource management requirements at present. Only through full scale operational systems tests can future requirements be defined. (2) Real time imagery is a "must" for detecting and monitoring forest fires.

A P P E N D I X 3

REPORT OF THE WORKING GROUP ON ARCHIVAL OCEAN INFORMATION SYSTEMS

The working group on archival ocean information systems was established "to identify and assess problems related to archival ocean information systems or data banks, including: appropriateness of stored data, user access, interaction with industry data banks, flow of data from real time to archival systems, and the impact of design of real time systems on archival systems". "Archival information", for purposes of the working group's discussions, was used in the broadest sense to include ocean related information, research data, analyzed research findings, survey results and other pertinent material, whether stored in computerized data banks or in paper files.

Early in the working group's deliberations, it became clear that:

(1) *Archived ocean data/information is a vital element of the foundation upon which the entire ocean management regime is based.*

In the first place, the formulation of marine policy and the planning of ocean management operations rely almost exclusively on information which is of a non real time nature. For example, effective oilspill contingency planning requires, as a first step, analysis and integration of stored data on environmental and oceanographic conditions, biological productivity, sensitivity of marine organisms to pollution, pollutant characteristics, and so on. Setting of fisheries quotas depends upon analysis from scientific models using historical data on fish catches, stock interactions and, increasingly, oceanographic information. Establishment of vessel traffic management regimes stems in large part from analysis and extrapolation of records of past shipping activity.

As a consequence of its role in the planning process, archival information, and the systems established for its handling and analysis, can be clearly seen as a core element of the context in which real time ocean management activities are carried out. Thus, this information provides the rationale for acquiring real time surveillance data and the perspective against which such real time data is evaluated. Indeed, the working group concluded that:

(2) *Any consideration given to the management of ocean-related information must recognize, as a basic principle, that the actual operations involved in ocean management are, to a significant degree, the result of a continuous, dynamic process of interaction between real time and archival information systems.*

Having reached these general conclusions on the overall role of archival systems, the working group arrived at specific findings with respect to: (a) linkages between archival systems; (b) linkages between archival systems and real time systems.

(a) Linkages between archival systems:

There is a growing tendency to require combination of disparate sets of archival data for the planning purposes associated with individual ocean management activities.

Numerous illustrations of this, both present and anticipated, were identified by the working group. Among these were: the need for marine biological data for purposes of oilspill contingency planning; eventual basing of ship routing procedures on regional environmental sensitivities; inclusion of physical oceanographic parameters in fish stock modelling; use of historical weather, sea state and ice information in oilspill modelling.

Working group members expressed concern that the meeting of these multi-disciplinary requirements is sometimes hampered by lack of access to existing data/information maintained by other groups or departments and, indeed, by a lack of knowledge of what information is already available. Given the predicted increase in these multi-disciplinary requirements, the expected ballooning of offshore activities (especially in the Arctic), and the cost of data acquisition, it is apparent that improved cross-referencing procedures will be necessary at all stages in the data acquisition and storage process. Therefore:

(3) More attention should be given to interdepartmental coordination in the planning and evaluation of various ocean activities and the associated data gathering and processing procedures.

(4) Consideration should be given to some form of clearing house or referral service which would maintain a centralized, easily accessed, up-to-date inventory of where various types of ocean information are stored and how access to this information may be arranged.

Increasingly, also, there may have to be more direct physical linkages between information systems maintained by different departments which have overlapping information requirements. This already exists, for example, between DOT and DOE/EPS with the NEELS system. The working group felt that present needs do no yet recommend a systematic approach to the establishment of such linkages, however:

(5) *Greater consultation among departments having overlapping data requirements should be a prerequisite for the establishment of data banks in order to minimize unnecessary duplication and to reduce future incompatabilities in hardware, data bank contents, and data format (recognizing in certain instances, as with the very large archives maintained by AES, that there are commitments to international format standards).*

One potential problem associated with improved archival system linkages is in the area of confidentiality. Often information is provided to the government, or more correctly, to a government agency, on the condition that this information will be used only for the purposes of the information system concerned. This is the case, for instance, with certain shipping information provided on a commercial confidential basis to the Coast Guard; it is also the reason why a tendency has occasionally been observed for fishing vessels, knowing their fishing locations will not be revealed, to report in to Coast Guard vessel traffic management stations rather than to DFO systems.

Given the wide variety of situations where confidentiality is involved, it was not possible to provide general recommendations respecting this issue. However, the working group did note with concern differing confidentiality requirements which exist vis-à-vis research data collected by industry in support of offshore drilling. In offshore areas under the administration of DIAND, this data has a one-year confidentiality period, with the result that environmental, oceanographic, and meteorological information is available for general archiving in a relatively short time span. (In fact, certain oil companies are now preparing their data in a machine readable format compatible with MEDS data bases.) However, south of 60°, a five-year period of confidentiality applies, and much offshore information which is of interest to users other than the offshore operators must be retained in EMR confidential files until the five-year period is over.

Correction of this anomaly is proposed in Bill C-20, the draft Canada Oil and Gas Act now before Parliament. It is to be hoped that early passage of this legislation or its successor will occur. In the interim, however:

(6) There should be an energetic continuation of the efforts begun by EMR to encourage industry pooling of offshore environmental and meteorological data.

This should have the effect of reducing proprietary interest in offshore data not directly related to the actual hydrocarbon resources, and should result in its earlier general availability.

The working group also noted that the contents of government ocean data archives may be the subject of requests under the new Freedom of Information Regulations. This may be of particular concern to regulatory agencies and might conceivably have longer-term implications for the collection and dissemination of surveillance data.

(b) Linkages between archival systems and real time systems:

A large proportion of information stored in archival systems originates in real time systems, either directly or after some form of processing. Several resulting problem areas were discussed by the working group.

The most obvious concern is with volume of data. Remote sensing techniques, particularly from satellites, threaten to completely swamp any non-selective approach to the archiving of their data/information products. On the one hand, the relative ease of acquisition of this material (assuming the continued existence and improvement of the surveillance systems involved) suggests that little special care need be given to archiving the data after its immediate useful purposes have been served. However, a more conservative archiving approach is supported by arguments that data often has eventual uses beyond those for which it was originally intended, and that new image enhancing and other processing procedures may greatly expand the applications to which old data can be put. In addition, increasing emphasis on multi-disciplinary use of archived data to examine long-term phenomena (e.g. climate change) urges that caution be used in discarding remote sensing data.

As a general approach to this problem the working group recommended that:

(7) *Systematic archiving criteria (resolution, area coverage, parameters to be stored, format, etc.) should be developed for each set of remote sensing data concerned.*

(8) *Long-term archiving requirements should be explicitly addressed in the planning of data processing procedures for real time systems.*

(9) *As a consequence of (7) and (8) above, not just primary users, but also secondary and other users must be fully involved in the coordinated establishment of requirements to be met by real time systems.*

Greater planing consideration of possible archival data use may also have an impact on the actual design of data processing systems. Presently, there is a strong tendency towards centralization of the specialized processing required for remote sensing data (especially from satellites). Primary users receive specific information products from the central processing organization; archiving remains the responsibility of the central processor and may be done in a less than systematic fashion with respect to possible user needs. However, a more concerted approach to maximizing data use for both real time and archival purposes might suggest consideration of a more decentralized process where users would "strip" relevant pre-processed outputs from the primary processor and subject these to further processing and archiving pertinent to specific user needs.

The working group also recommended coordinated user involvement in real time system planning in order to ensure compatibility of new data with that previously archived. Despite commonalities of vocabulary, the parameters measured by different techniques may have completely different meanings. For example, sea surface temperature measurements by satellite differ, in terms of both area and thickness of "surface", from measurements taken by Nansen bottle; moreover, neither surface temperature may meet requirements for, say, search and rescue or fisheries stock modelling purposes. Ultimately, the working group concluded that:

(10) *There should be a greater emphasis during the design phase of remote sensing data acquisition systems on comparing projected data products with corresponding parameters already archived.*

This would tend to reduce incompatibilities between new and existing data bases and decrease the possibilities that the introduction of new technologies might severely limit the applicability of valuable historical data bases. Additionally, such improvements in the planning process could perhaps expand the usefulness and speed up user acceptance of newer remote sensing technologies.