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Ice Data Management Systems

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ICE DATA MANAGEMENT SYSTEMS

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SUMMARY

Oil and gas companies engaged in exploration and production drilling off the coast of Newfoundland and Labrador must cope with the seasonal presence of pack ice and icebergs. The means whereby the companies deal with ice encroachment into the drilling area is known as ice management. A component of ice management - the management of ice information - is known as ice data management.

In late 1983, the three oil companies planning drilling programs in winter 1984 responded to a set of regulatory guidelines/directives regarding winter drilling on the Grand Banks by establishing a cooperative arrangement known as the Grand Banks Operators' Joint Ice Management Plan. In 1984 and 1985, the plan called for the establishment and operation of a central land-based ice data management system. This study was directed at an analysis of the 1985 system and at future ice data management requirements.

The downturn in exploration drilling offshore Newfoundland and Labrador which began in 1986 has led to the implementation by the active drilling companies of a decentralized joint ice data management system. In view of the forecast of a continued low level of drilling activity, it is concluded that the decentralized system is better suited to industry and regulatory requirements. The conceptual design of such a system includes standardization by industry of the specifications each company provides to the contractors who provide data communications services and ice data management system components. It is recommended that a working group be established, to include representatives of the oil industry, industry regulators, ice management contractors and other interested parties, to develop a detailed specification whereby the subsystems in a decentralized system can most efficiently and effectively meet the data management requirements of the Joint Ice Management Plan.

RÉSUMÉ

Les sociétes pétrolières et gazièires engagées dans des tranvaux de forage de prospection et de production au large de terre-neuve et du labrador doivent faire face à la présence saisonnière de banquise et d'icebergs. les techniques de gestion des glaces leur permettent de régler les ennuis causès par la formation de glace à proximité des installations de forage. un élément important de la gestion des glaces est donc la gestion des données relatives aux glaces.

À la fin de 1983, les trois sociétés petrolières qui envisageaient réaliser des programmes de forage à l'hiver de 1984 ont donné suite à une série de lingnes directrices visant la réglementation des travaux de forage hivernaux dans les Grands Bancs, en constituant une coentreprise connue sous le nom de *Grand Banks Operators' Joint Ice Management Plan.* En 1984 et en 1985, le plan faisait appel à l'elaboration et à l'exploitation d'un systéme central terrestre de gestion des données relatives aux glaces. L'etude a surtout porté sur l'annalyse du systeme de 1985 et sur les besoins futurs en matiére de gestion des données relatives aux galces.

Le ralentissement des activités de forage de prospection au large de Terre-Neuve et du Labrador, qui s'est amorcé en 1986, a poussé les sociétés actives à établir un systéme decentralisé conjoint de gestion des données relatives aux glaces. Devant les projections selon lesquelles les activités de forage maintiendront leur rythme lent, on a jugé que le systéme décentralisé se prêtait mieux aux exploitants en services de réglementation et aux besoins de l'industrie. Ce systéme fait appel à la normalisation, par l'industrie, des spécifications que chaque entreprise fournit aux exploitants en services de commmunication des données et en éléments de systémes des gestion des données relatives aux glaces. On a recommandé la mise sur pied d'un groupe de travail composé de représentants de l'industrie pétrolière, d'organismes de réglementation de l'industrie, d'exploitants en gestion des glaces et d'autres parties intéressees chargé d'élaborer des critéres précis permettant aux sous-systémes à l'intérieur d'un systéme décentralisé de respector le mieux possible les exigences du *Joint Ice Management Plan* en matiere de gestion des données.

1.0 INTRODUCTION

For the past several years, a number of major oil companies have been drilling exploration wells for oil and gas in the Grand Banks - Flemish Pass area off the east coast of Newfoundland. As of early 1983, Mobil Oil Canada, Ltd. (Mobil) was the only company drilling in the area; specifically, on the Hibernia structure. In late 1983, two other organizations, Husky/Bow Valley East Coast Project (H/BV) and Petro-Canada Inc. (PCI), began exploration drilling programs in the general vicinity of Hibernia. As a group, these operators became known as the Grand Banks operators.

In the fall of 1983, the Canada Oil and Gas Lands Administration (COGLA) issued a set of guidelines to the Grand Banks operators intended to improve and ensure an adequate level of safety in offshore operations. The guidelines stipulated that "Operations on the Grand Banks should, during the winter months, be carried out so that drilling units are located in close proximity". The guidelines required that the operators develop cooperative operating arrangements on a joint basis, one of which was the following:

"All operators on the Grand Banks are to put into place a plan for joint ice management of pack ice and icebergs, including the cooperative use of vessels and aircraft in ice surveillance and iceberg towing" (COGLA, December 1983).

The measures to accomplish this objective were elaborated upon by the Newfoundland and Labrador Petroleum Directorate (NLPD) as follows:

a) coordination of vessel traffic for the purposes of ice and iceberg reconnaissance
b) coordination of supply vessel movement for the purposes of iceberg towing strategies
c) establishment of a central data collection center
d) coordination of aircraft surveillance
e) arrangements for extra vessels for reconnaissance and towing if necessary
f) provision of suitable remote sensing capabilities when required during periods of low visibility.

"Operators must make arrangements to provide the Petroleum Directorate with regular status reports of ice and iceberg conditions and short term forecasts. Additionally long term pack ice and iceberg forecasts must be provided and updated when required." (NLPD, October 28, 1983)

As a result of these guidelines/directives, the three operators established a cooperative arrangement and submitted a plan to COGLA known as the Grand Banks Operators Joint

Ice Management Plan. This was submitted in late November 1983 and implemented in time for the start of winter drilling operations in January 1984.

Part of the joint ice management plan required the creation of a central facility responsible for the collation of industry and external data inputs of pack ice and iceberg observations, for generation of short term and longer term forecasts of movements of pack ice and icebergs, and for production of a daily ice status report. In 1984, this facility was operated under contract by NORDCO Limited of St. John's. NORDCO had been providing a somewhat similar service for Mobil (although much more reduced in scope) prior to the arrival of the other operators.

Longer term forecasts had been contracted out separately in 1982 and 1983. These forecasts did not seem to be very useful to the operators because of their inaccuracy. In 1984 this requirement was discontinued, and it was not a requirement of the central facility.

In 1985 the contract to operate the centralized ice data management system (IDMS-85) was bid competitively. Dobrocky Seatech Limited of St. John's was the successful bidder.

This study was commissioned in mid-1985 as a result of responses to a Request for Proposals issued by the Environmental Studies Revolving Funds on April 10, 1985. As stated in the request, "The objective of this program is to document clearly the existing data dealing with ice management for the Grand Banks; to assess the requirements for an ice data product distribution system; and, to recommend a reliable, efficient, and cost-effective regional ice data management program for the Grand Banks region." Dobrocky Seatech Limited, in association with Norland Science and Engineering Limited and Lapp-Hancock Associates Limited of Ottawa, was the successful bidder on the project. The original scope of work for the project consisted of four phases:

- I - Analysis of IDMS-85
- II - Analysis of User Requirements
- III - Functional Specifications for Future Systems
- IV - Final Report

For a number of reasons, the duration of the project was protracted a considerable extent. The changes in the operating philosophies of oil companies and the changes in ice data management since 1985 have necessitated revisions to the original scope of work for this study, as reflected in this document. The most important change affecting the study has been the discontinuation of the use of a central ice data management facility and the implementation of a decentralized approach.

This report is divided into seven sections, of which this is the first. Section 2 provides an overview and history of Grand Banks ice data management. Section 3 and 4 present the results of Phase I and II, respectively, of the original scope of work. Section 5 contains a discussion of the developments since 1985. Section 6 discusses future ice data management systems. Section 7 presents the conclusions of the study.

2.0 OVERVIEW OF GRAND BANKS ICE DATA MANAGEMENT

Throughout this study, the term "ice data management", as it applies to activities undertaken in support of oil and gas exploration and production off the East Coast of Canada, encompasses:

1. Acquisition, collation, quality control, analysis, and archiving of ice and other data at various locations (on rigs, at shore bases, etc.).

2. Forecasting of iceberg and pack ice conditions for the area in question. Forecasts range in duration from 6 to 96 hours. The forecasts are generated at a number of locations.

3. Presentation of data and data products for use by decision makers and regulators.

Ice data management for the Grand Banks region is directed at three levels of information requirement: tactical, strategic, and regional. These levels correspond to the three ice management zones centered on any one drilling operation. The tactical zone associated with each drilling operation is an area centered on the rig location and extending a variable distance as necessary to ensure safe and economical operations. Although the distance varies among operators according to the type of drilling unit used and the nature of individual ice contingency plans, and also changes in response to variations in ice conditions, it is generally on the order of 10 to 25 nautical miles (nmi). On the tactical scale, ice information is required on a continuous basis. Ice observers are stationed onboard the rig to provide ice management support on a 24 hour per day basis. The observers obtain information directly through the use of marine radar, visual methods, and environmental sensors. Assisted by the onboard radio operators, they also obtain information from other field sources, including the vessels and helicopters supporting the rig, and from information services on shore. The information is processed by the observers, in most cases using a computer-based data management system, and a variety of data and data products, including short term (6 to 24 hours) ice drift forecasts, are provided to senior drilling and marine personnel onboard the rig and operations and management personnel at the shore base. The shore base personnel in turn provide the information to other groups as appropriate, including regulators, partners, other operators, and a central facility, if one exists. Tactical decisions are generally taken on the rig, with a level of input from shore base personnel as determined by the situation and the style of the operator. These decisions are focussed on operations in the short term, i.e. less than 48 hours.

The strategic ice management zone extends beyond the tactical zone and can be roughly defined as that area for which information is required to support the planning of drilling operations in the medium term (2 to 4 days). The distance that the zone extends from the rig varies according to the ice management practices of the rig operator and the nature of prevailing ice conditions. Some operators wish to regularly obtain strategic information on ice conditions in an area up to 75 nmi from the rig; others are only marginally interested in ice conditions outside the tactical zone. When ice conditions are favourable (for example, when there is no ice within, say, 100 nmi of the rig), the strategic zone may increase in size as resources are available to obtain information farther afield; when ice conditions are severe (for example, when there is ice within, say, 15 nmi of an anchored semi-submersible), the zone size is reduced as resources are dedicated to tactical support. Industry surveillance of the strategic zone is conducted primarily using fixed-wing aircraft staffed by ice observers and equipped with some form of airborne radar. Flight frequency varies according to the nature of ice conditions, but is generally not less than twice weekly during the ice season. Surveillance is also carried out by vessels deployed on ice patrols. Supplementary information can be obtained from vessels and aircraft en route through the area, from Atmospheric Environment Service Ice Branch (AES) and, via AES, from the International Ice Patrol (IIP), whose airborne reconnaissance covers the region. Information can also be obtained from Canadian Coast Guard (CCG). CCG retransmits ice reports received from ships and other traffic. In addition, information collected in the tactical zone of one operator may be relevant to the strategic zone of another operator. Ice management on a strategic scale involves collecting and rationalizing data from all sources, obtaining a medium term forecast (48 - 96 hours) of ice conditions, and making medium term planning and resource allocation decisions in light of the observed and forecast conditions. These tasks are conducted largely by shore-based personnel. Information is prepared by each operator's environmental department and presented to operations and management personnel for action. Rig-based personnel receive the information and participate in decision-making to a degree determined by the style of the operator.

The regional zone covers the entire east coast and is of interest from the point of view of anticipation of future ice conditions. Aside from pre-season aerial reconnaissance and occasional flights during favourable ice conditions, industry does not generally sponsor reconnaissance of the regional zone. Regional scale information is obtained from AES, IIP, and CCG, whose mandates require large scale coverage off the east coast. Information is obtained and managed by shore-based personnel in conjunction with tactical and strategic information.

Figure 1 depicts the ice management zone configuration for a single rig. Figure 2 illustrates the components of ice data management for the rig operator. Tactical ice data is collected on the rig on a continuous basis by the ice observers and radio observers. Information is presented to senior drilling and marine personnel on the rig and through the shore-based radio operators to the operator's environmental department. Radio and satellite communications are utilized, and on some rigs and at some shore bases, ice data management computer systems are installed for data communications and processing. Tactical, strategic, and regional ice data are obtained at the shore base by environmental

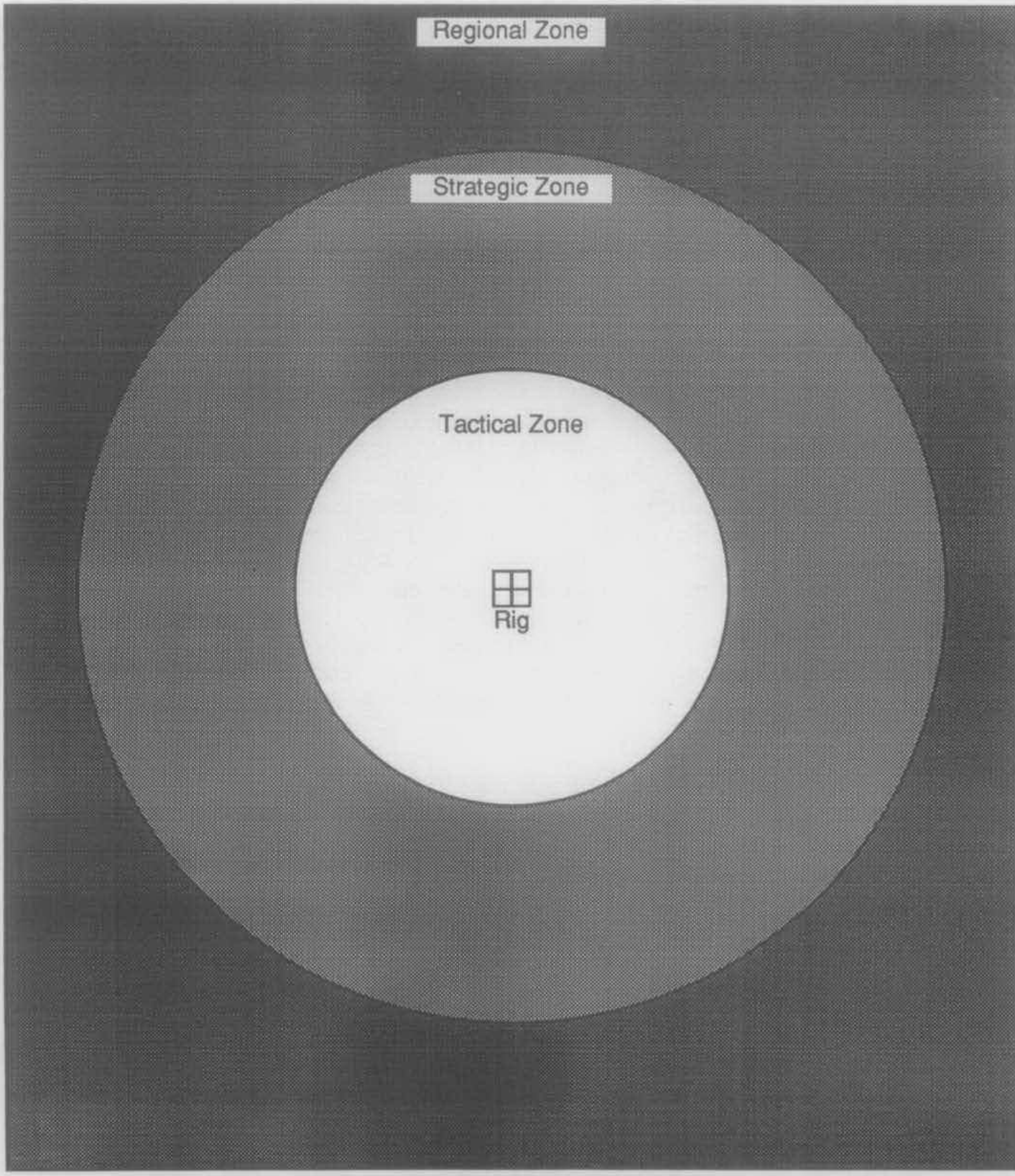


Figure 1 Ice Management Zones for a Single Rig.

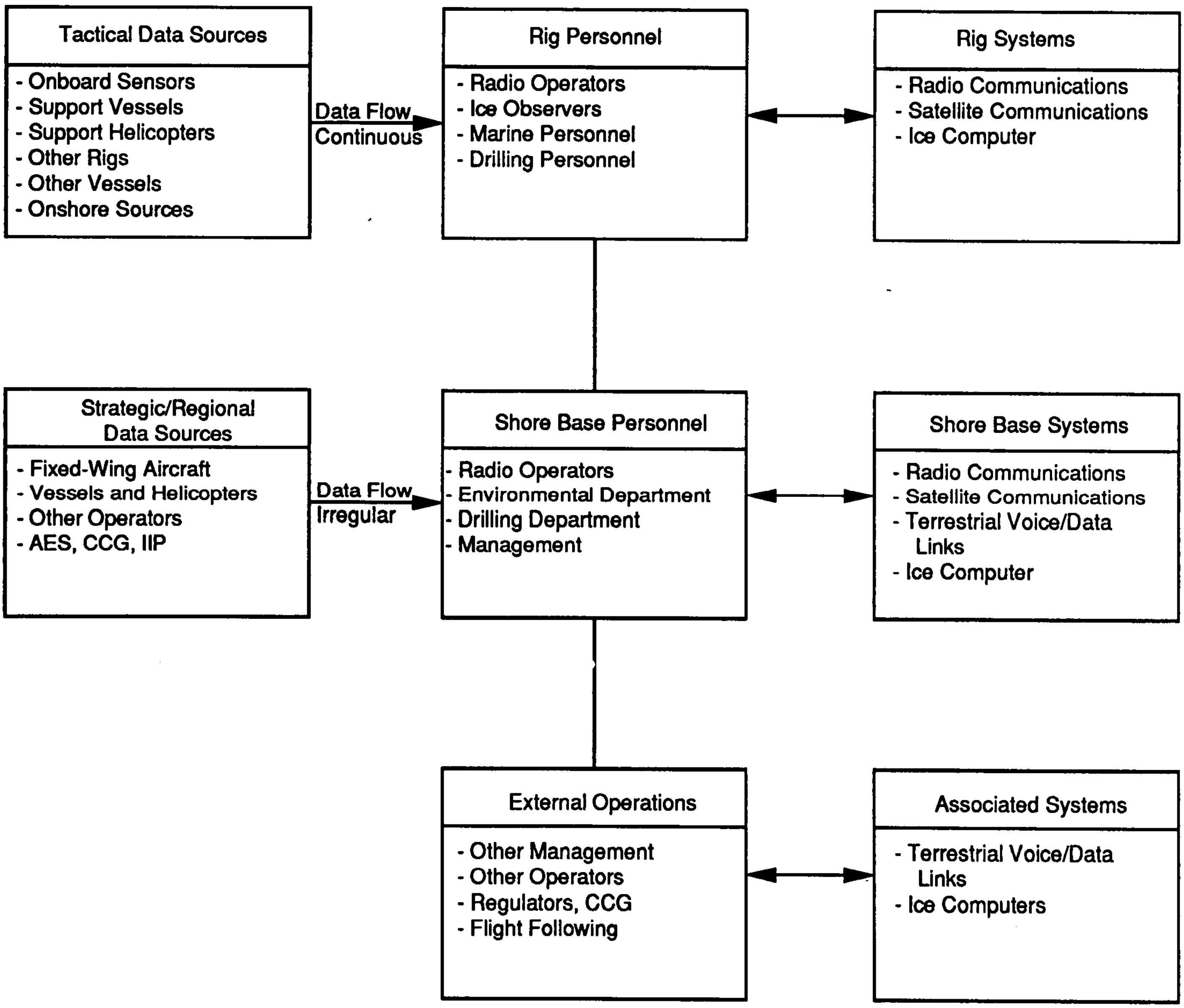


Figure 2 Ice Data Management Components.

department personnel and radio operators. All required information is presented to operations and management personnel for action. Information is reported to other groups as appropriate.

Figure 3 depicts the ice management zone configuration for a multiple rig/multiple operator drilling scenario similar to the configuration at one point in 1985. At the time, there were three companies operating a total of five rigs in relatively close proximity. The figure depicts a considerable overlap of tactical and strategic zones. The overlap at the tactical level necessitates close cooperation among the rigs and support vessels to ensure that measures taken at one location do not result in creation of a hazardous situation at another. To support such cooperation, it is necessary that the multiplicity of information collected be commonly referenced, e.g. that common iceberg identifiers be used. The overlap at the strategic level and the commonality of regional interests are best accommodated through a sharing of resources and information. Reconnaissance resources can be shared to provide data for a common strategic zone which encompass the strategic zones for all rigs. This data, and the data provided by AES, IIP, and CCG can be rationalized to provide identical information to all operators.

The program for sharing ice management data and resources introduced by the active Grand Banks operators in late 1983 included a data management component requiring standardized reporting by industry sources, establishment of a central land-based facility to rationalize and process data collected by industry and non-industry sources, and routine production of a set of ice data products for the common use of operators and regulators. The following section contains an analysis of the central land-based facility used in 1985.

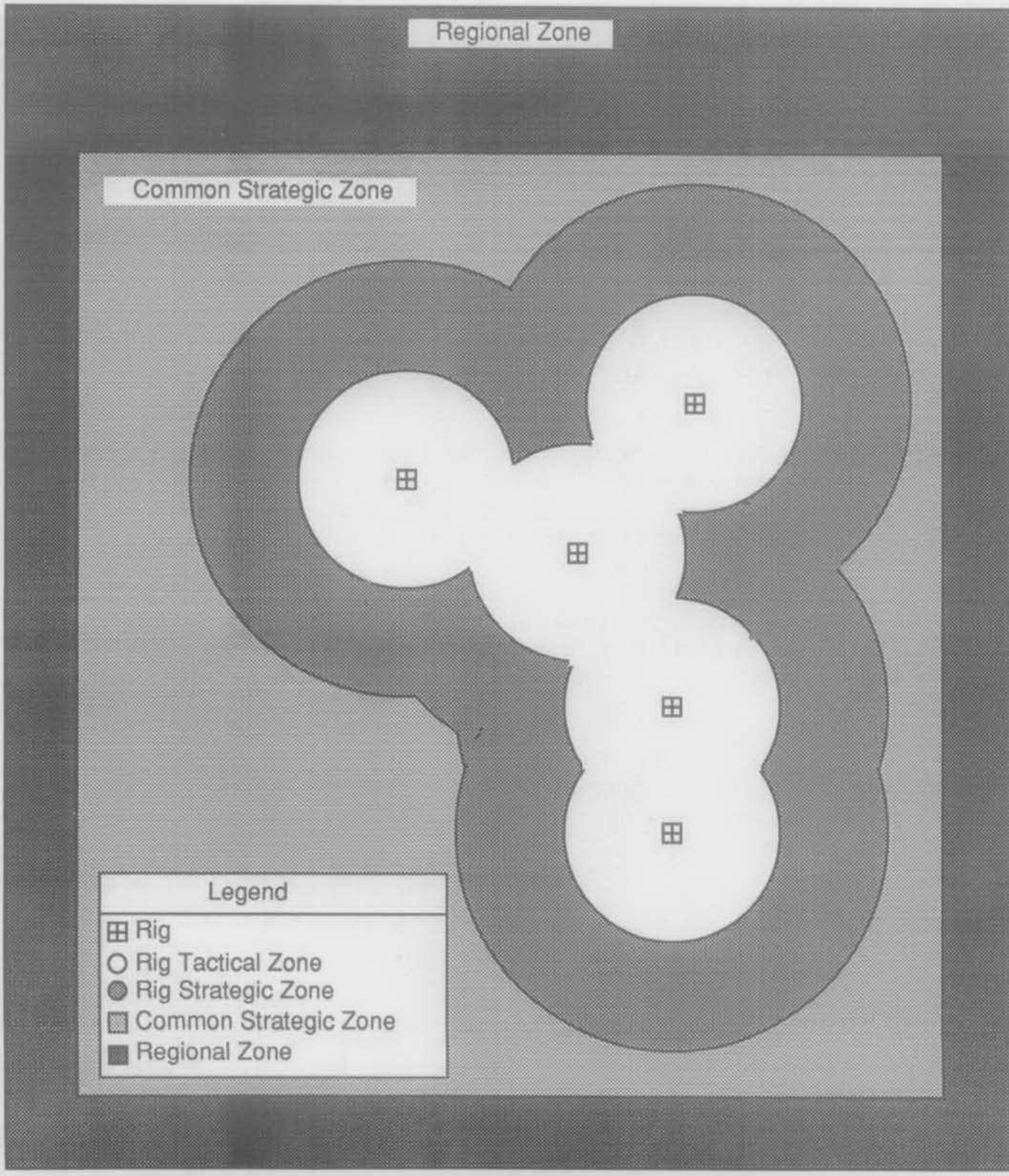


Figure 3 Ice Management Zones for Multiple Rigs.

3.0 ANALYSIS OF IDMS-85

This section presents the findings of an independent assessment of IDMS-85 carried out by Norland Science and Engineering Limited and Lapp-Hancock Associates Limited. The purpose of the assessment was to review in detail the 1985 operational system and to draw conclusions on its effectiveness, efficiency and economy.

3.1 Description of IDMS-85

In the second year of its existence, IDMS commenced operation on January 12, 1985. The system operated for the following 193 days, with service being discontinued on July 23. The central facility was established on the premises of Dobrocky Seatech Limited in St. John's.

At the time of start-up, there were five semi-submersible rigs drilling on the Grand Banks for three operators - Mobil, H/BV and PCI. H/BV and PCI each operated two rigs while Mobil operated one. All three operators had their shore bases located in or near downtown St. John's whereas IDMS was operated approximately 11 kilometres from the downtown area.

Later in the year Esso Resources Canada Limited (Esso) commenced drilling off the Flemish Cap using a dynamically positioned semi-submersible rig. Esso elected to join IDMS starting on May 1, 1985 and continued participating until the service was discontinued.

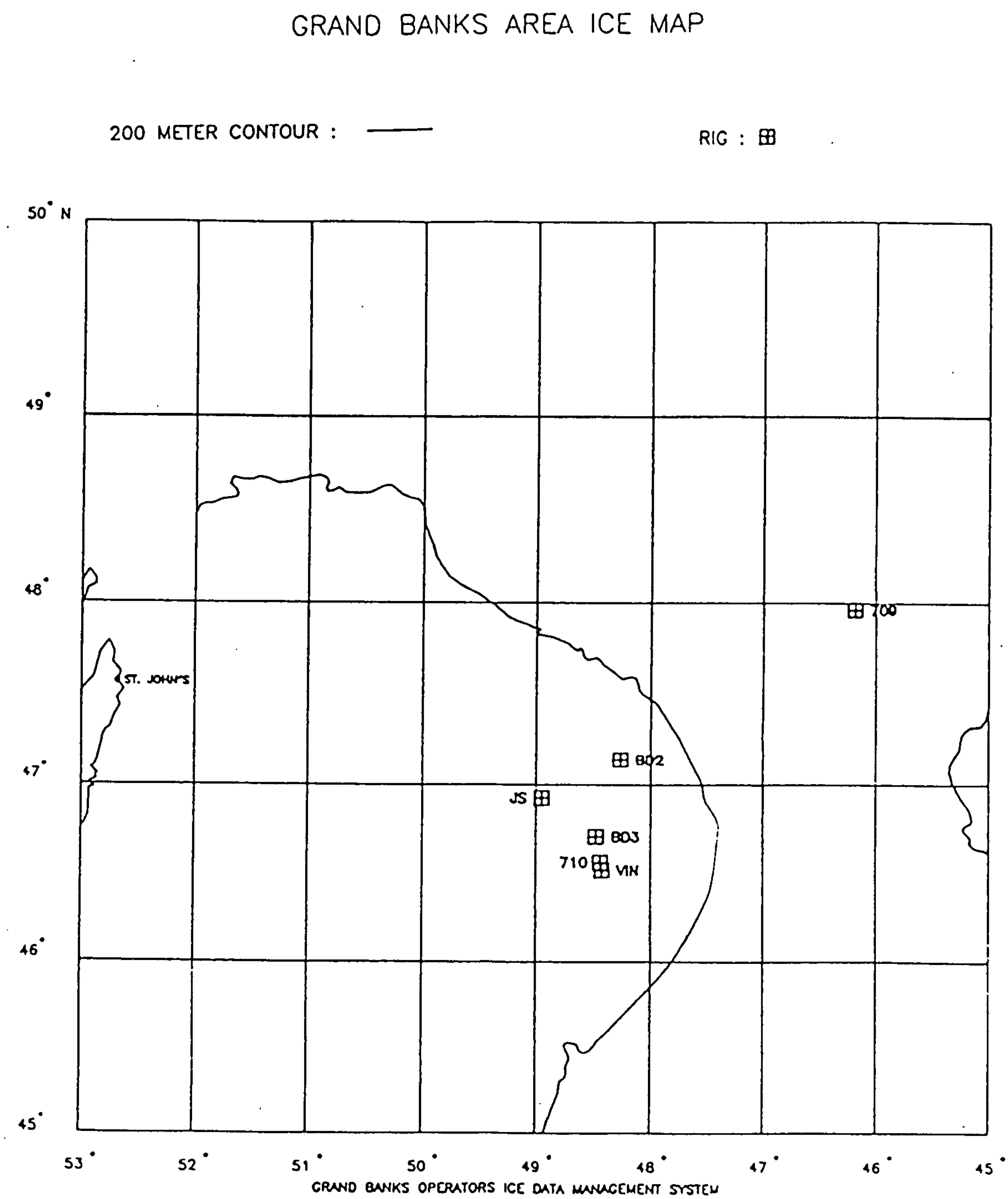
The locations of the six rigs in relation to the Grand Banks and Flemish Pass are illustrated in Figure 4, which also displays the 200 metre (m) depth contour. The rig nomenclature and controlling companies were as follows:

1. 709 - SEDCO 709, dynamically positioned semi-submersible rig, Esso Resources Canada Ltd.

2. BD2 - BOW DRILL 2, anchored semi-submersible rig, Husky/Bow Valley East Coast Project

3. BD3 - BOW DRILL 3, anchored semi-submersible rig, Husky/Bow Valley East Coast Project

4. JS - JOHN SHAW, anchored semi-submersible rig, Mobil Oil Canada, Ltd.



Code:
- 709: Sedco 709
- BD2: Bow Drill 2
- BD3: Bow Drill 3
- 710: Sedco 710
- VIN: Vinland
- JS : John Shaw

Figure 4. Locations of East Coast Drilling Sites During 1985

5. 710 - SEDCO 710, anchored semi-submersible rig, Petro-Canada Inc.

6. VIN - VINLAND, anchored semi-submersible rig, Petro-Canada Inc.

It is readily apparent from Figure 4 that five of the rigs were operating in close proximity to one another, as was originally required by COGLA in the winter drilling guidelines. The five rigs were clustered in a rough circle of some 50 kilometres (km) in diameter.

Table 1 chronicles the significant events which occurred with respect to the rigs in the drilling area over the period when IDMS was operating. Pack ice severely limited drilling during the first two and one-half months of IDMS operation with most of the rigs returning to port by the middle of February for annual refit and to await an improvement in ice conditions. The first icebergs were reported on February 4 but icebergs did not significantly affect drilling operations until April. During that month numerous encounters with icebergs were experienced with the result that many of the rigs, especially the ones closest to the 200m contour, which is near the approximate western edge of the Labrador current through the Flemish Pass, were occasionally forced off location for periods of up to 8 or 9 days. After the beginning of May, there were still large numbers of icebergs reported on the IDMS system, but their proximity to rigs was such that there were few occasions when the rigs were forced off location. The northernmost rig, the BOW DRILL 2, had the highest frequency of encounters with icebergs, mainly due to its location being closer to the higher density ice and iceberg regime.

It is important to understand the regional pattern of ice and iceberg movements in the Grand Banks - Flemish Pass region at least in a general way. These patterns underlie some of the operations performed at the IDMS facility, particularly forecasting and quality control. It is impossible to fully describe the complex regime of ice and iceberg distribution and movement. Figure 5 illustrates the prevailing currents and main flow of icebergs through the Grand Banks area.

Although there are some exceptions, some general trends can be summarized:

1. Most of the icebergs stay outside the 200m contour and generally follow along its length. At the top of Flemish Pass the main flow of icebergs turns southward, although a certain unknown percentage of icebergs drift eastwards along the north side of the Flemish Cap.

2. The 200m contour is a rough demarcation line between two categories of iceberg drift patterns observed in the Grand Banks area. Icebergs outside the 200m contour are principally driven by the strong Labrador currents. On the Grand Banks, the current regime is weaker and less directional so that iceberg movements are more influenced by prevailing winds, and individual storm systems. Their movements

Table 1

Chronology of Major Events During 1985

Date	Event
January 12	IDMS operational services begin at Level 1 Service.
January 25	Sedco 706 completes operations at Panther p.52 location for Husky/Bow Valley.
January 26	Vinland begins operations at Trinity H-71 location for Petro Canada.
February 2	Bow Drill 2 off location, at Conquest K-09 due to pack ice.
February 3	Bow Drill 3 and Vinland off location, due to pack ice.
February 4	Bow Drill 2 arrives Marystown. Bow Drill 1 and John Shaw off location.
February 8	Vinland arrives at Argentia.
February 9	Bow Drill 3 arrives Mortier Bay.
February 10	John Shaw arrives Mortier Bay.
February 11	Bow Drill 1 arrives Argentia.
February 19	Bow Drill 2 departs Marystown en route Archer K-19 location.
February 21	Bow Drill 2 arrives K-19.
February 24	Bow Drill 2 completes operations at Archer K-19. Under tow to south of leading ice edge.
March 12	Bow Drill 2 returns to Marystown. All rigs now in port.
March 25	Bow Drill 3, Vinland under tow en route to drilling area.
March 26	Bow Drill 1 and 2 en route to drilling area.
March 27	John Shaw en route to drilling area. Bow Drill 2 waiting on ice. Bow Drill 1 and 3 and Vinland on location.
March 29	John Shaw on location.
April 1	Bow Drill 3 off location.
April 2	John Shaw off location.
April 3	Bow Drill 1 en route to Argentia.
April 9	Bow Drill 3 on location.
April 10	John Shaw on location.
April 12	John Shaw and Bow Drill 3 off location.
April 15	John Shaw on location.
April 18	Bow Drill 3 on location.
April 20	Sedco 710 arrives West Ben Nevis B-75 location. Bow Drill 3 off location.
April 21	Bow Drill 2 on location.
April 22	Bow Drill 3 on location.
May 1	Bow Drill 2 and 3, John Shaw, Vinland, and Sedco 710 on location. Sedco 709 en route to Baccaliu I-78. Esso joins IDMS.
May 28	Bow Drill 2 off location due to iceberg.
May 30	Bow Drill 2 on location.
July 23	Last day of IDMS service.

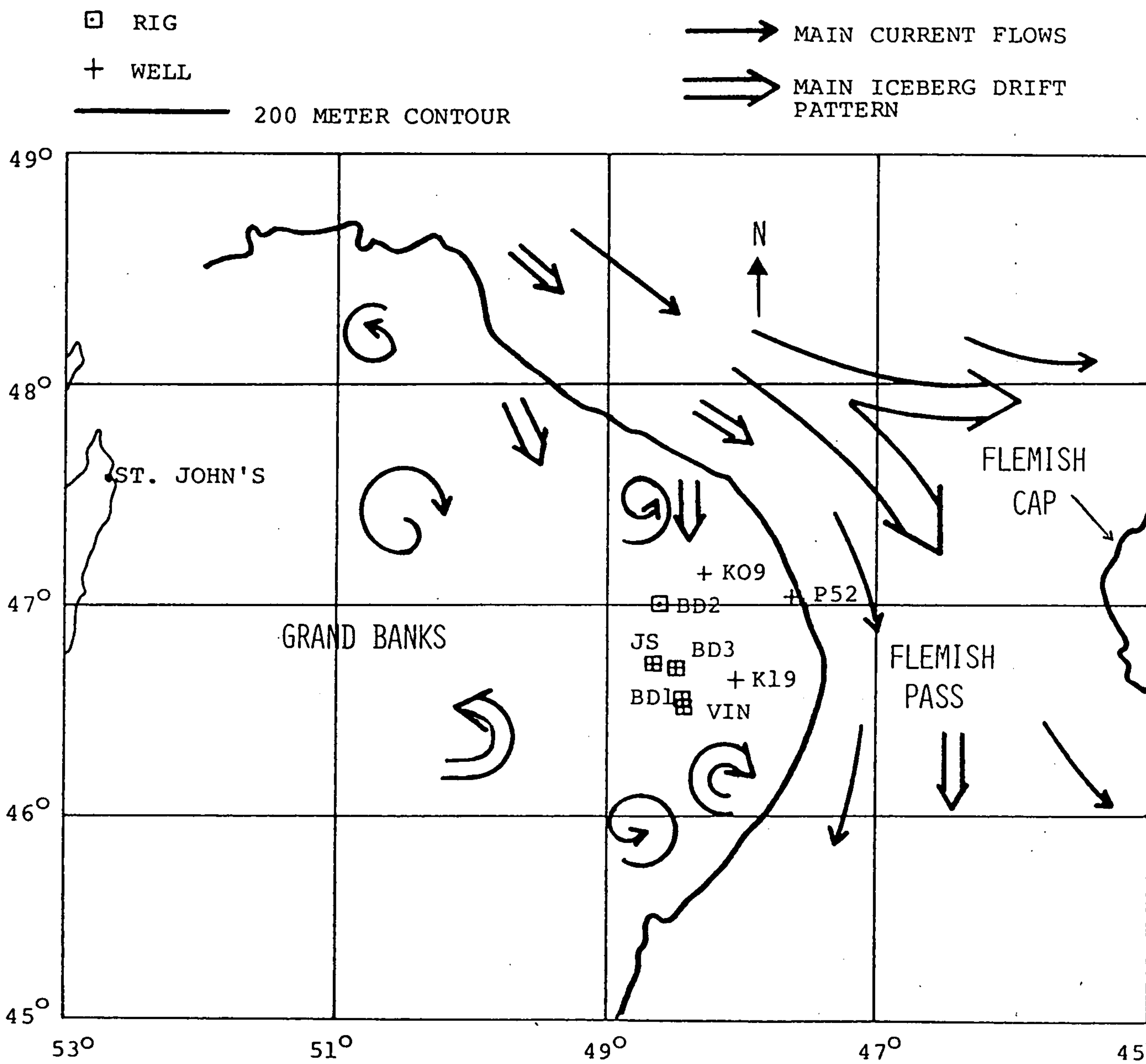


Figure 5. Grand Banks Regional Ocean Current and Iceberg Drift Regime

are thus generally less predictable, and grounding occurs more frequently because of the shallow bathymetry.

3. The extent of pack ice encroachment on the Grand Banks varies from year to year. In 1985 the pack ice edge was much further south and east than average and it was the major interference to drilling during February and much of March.

4. The Grand Banks area is characterized by extended periods of heavy fog and high winds which can change rapidly in strength and direction.

3.1.1 Overall IDMS System Operation

IDMS was configured to address the requirements of the Joint Ice Management Plan developed by the three operators in late 1983 and to meet the specifications developed by the operators for the 1985 system. The flow of data for IDMS as it existed in 1985 is illustrated in Figure 6. The various sources of input data included those from industry, either directly or sponsored by them and from government agencies. The IDMS facility represented the hub of information flow for both input and output.

Industry-supplied data included reports from rigs, vessels and helicopter reconnaissance. These data were transmitted to IDMS via the operators' shore bases. Each company designated an ice control rig through which ice information from other rigs, vessels and helicopters was sent along with their own reports to shore base. In the case of H/BV, the information flow from vessels and helicopters was sent directly to shore base by HF radio voice transmission with the rigs copying the information as it was sent. PCI designated the SEDCO 710 as their ice control rig. The ice control rig had control over the supply vessels at its disposal, and it would dispatch many of them to conduct surveillance sweeps of areas in search of icebergs or instruct them to tow or propwash icebergs if needed. The other rig would recommend areas to be searched to the ice control rig. Although Figure 6 does not explicitly show it, there was a great deal of information exchange between vessels and rigs from all the operators. There was also some amount of swapping of support vessels depending upon the prevailing ice and weather situation, the activity on the rigs, as well as vessel availability.

Ice reconnaissance was sponsored by industry using two different aircraft, one of which provided a visual reconnaissance service using ice observers, and the other, an aircraft equipped with Side-Looking Airborne Radar (SLAR) provided a radar surveillance service. The visual and SLAR aircraft were managed by Mobil and H/BV respectively. The areas to be searched by the reconnaissance aircraft were decided through consultation among the three operators' ice coordinators. If one operator wished to have an area searched on behalf of his rigs on any given day, he would contact the other coordinators to

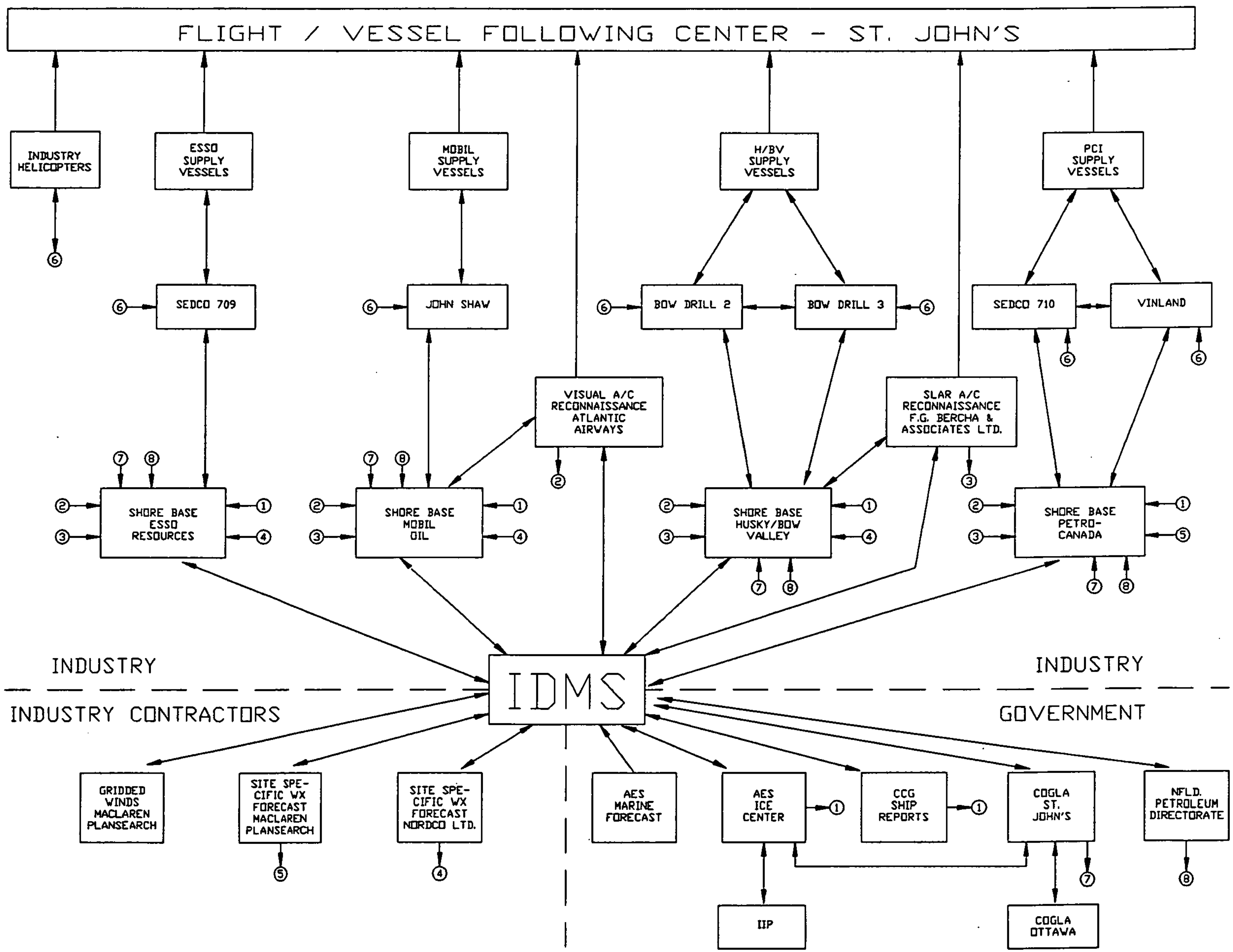


Figure 6. IDMS Data Flow 1985

see if they wished to participate in the flight as well. Whoever wished to have some area searched would then pay a proportionate share of the costs of the flight. Thus certain reconnaissance flights had the participation of just one, two or all three operators. The merits of this arrangement will be discussed further in Section 3.2.

When Esso joined IDMS, they sponsored some visual reconnaissance flights on their own behalf. Esso was much further away from St. John's, and so any visual flight had to be dedicated to them because of the fuel range limitation of the aircraft and also because Esso's areas of interest were of less interest to the other operators.

Information from the reconnaissance aircraft were sent directly to IDMS, and were also sent to the shore bases of each operator who had participated in the flights, as well as to the rigs in the form of voice contact on VHF directly from the aircraft.

All industry vessels, rigs, helicopters as well as the visual and SLAR aircraft were required to report to the Flight Following Center located near St. John's airport. This industry-sponsored center served as a control and information facility intended to keep track of the status of all industry traffic. Vessels, for example, were required to submit a vessel status report to Flight/Vessel Following Center every 4 hours. Information on all drilling units, vessels and aircraft activity was passed on to IDMS and incorporated into their computer system.

Industry also provided IDMS with the site-specific weather forecasts for each drilling location as well a special area analysis and prognosis of wind, in gridded format (gridded winds), the latter for input into the computerized ice and iceberg forecast models. The site-specific weather forecasts were provided by two different companies under contract to the respective operators. It should be noted that the weather data from the Grand Banks provided to these companies was only from those rigs and vessels of the sponsoring operator. For example, NORDCO, under contract to H/BV, did not have real-time access to data from the JOHN SHAW, a rig operated by Mobil.

External sources of ice and iceberg data were AES Ice Branch in Ottawa; IIP through AES; and CCG in St. John's. AES Ice Branch provided pack ice information in the form of current (daily) and composite (weekly) charts as well as in message format. Messages also included an outlook of pack ice conditions over the next 24 to 48 hours. Iceberg reports were sent in the form of telex messages according to a code developed by AES and IIP. Both AES and IIP iceberg data were based on an analysis of SLAR imagery with as much visual confirmation as possible. IIP iceberg charts were transmitted from Gander to AES for dissemination to Canadian users and to the IIP headquarters in New York. CCG received ship reports from vessels passing through the area which were passed on to IDMS and all the shore bases. The AES marine forecast was also accessed by the IDMS center.

The data stored in the IDMS computer system was accessed by three of the operators using remote workstations linked to the computer via dedicated data modems and telephone lines. The shore bases could create subsets of the total available set of data products for distribution to their respective rigs, shore-based office staff and head offices. Esso did not use a remote workstation, but received a specified set of data products via telecopier.

Products were also distributed via telecopier from IDMS to COGLA St. John's. NLPD and AES Ice Branch received data products through COGLA St. John's. One product was sent to AES Ice Branch by COGLA five days a week.

3.1.2 Input Data Sources

This section will briefly describe the input data provided to IDMS via the channels previously described. Examples of the formats of ice and weather information are included in Appendix A.

Sources of input information can be divided into industry and external classes. In general, industry data reporting was not on a scheduled basis in terms of IDMS, because the rigs and vessels were only required to report when ice was detected. When ice was detected, the frequency of reporting varied from every half hour to every 6 hours depending upon the operator and the ice situation. The only scheduled data input was industry-sponsored weather forecasts and gridded winds. External data sources included AES, whose current and composite charts were produced on a scheduled basis although access was at the discretion of IDMS. Sea-ice and iceberg data from individual AES flights were not scheduled. CCG ship reports were sent on an unscheduled basis whenever a report was received by the CCG traffic center.

INDUSTRY SOURCES

These included rigs, vessels, helicopters, visual and SLAR aircraft, and weather forecasting contractors.

Rigs: Each rig had on board a minimum of two ice observers whose prime responsibility was to monitor the tactical ice situation in the vicinity of the rig. They also provided advice on the deployment of vessels for ice reconnaissance and provided input into towing decisions. The observers also conducted weather observations and ocean current measurements. Each observer worked on a 12 hour shift daily. The primary data products which the observer produced were a rig ice report (Figure A-1, Appendix A) and the vessel routing report (Figure A-12), both of which were filed on a regular basis when ice and/or icebergs were being monitored. The vessel routing report was sent to the operators' shore bases in St. John's and forwarded to Flight Following in St. John's and to IDMS. This report was filled out prior to the start of a reconnaissance sweep.

Depending on the rig (whether it was an ice control rig or not) and the operator, the ice observer could also be responsible for filling out the vessel ice report described below. He would receive the vessel reports, collate them and pass them on to shore base. The observer also received information directly from the visual and SLAR aircraft by radio and talked to the other rigs to obtain additional information in their areas.

Vessels: Their primary input was the vessel ice report (Figure A-2) completed on a regular basis as specified in the vessel routing instructions. When an iceberg was detected the vessels were required to report position, measure or estimate its dimensions, drift speed and direction as well as assess its towability. They were required to determine this information upon initial encounter and then to report it either to the ice control rig or shore base depending on the operator. Instructions were then given to them regarding the frequency of subsequent reporting which was dependent on the location of the iceberg with respect to the rig as well as the number and distribution of other icebergs in their general vicinity.

The vessels generally conducted a prescribed search pattern dependent on weather and ice conditions. This pattern was dictated usually by the rig although in 1985 it was sometimes controlled from shore base.

The vessel ice report was usually compiled by the captain or chief mate, although one vessel did have its own ice observer dedicated to that task, along with the provision of side scan sonar draft measurements of icebergs.

Helicopters: This was a comparatively minor source of ice data for IDMS, but some operators utilized helicopters for reconnaissance either while in transit to and from St. John's or for tactical surveillance from the rig. A helicopter reconnaissance report was completed, (Figures A-4 and A-5). This report was passed along to the rig observer who sent it on to shore base.

Visual ice reconnaissance: The reconnaissance was contracted by Mobil from Atlantic Airways Limited of St. John's, who provided the aircraft. A separate contractor provided aerial observers. The aircraft was a Beechcraft Super King Air B200 equipped with an Omega nargation system.

On each flight the aircraft flew one, or some combination, of a series of standard flight lines which had been previously determined jointly by the operators cost-sharing the service. The pattern to be flown was decided through consultation among the operators wishing to participate in the flight, and the pilots. They generally flew at about a 2,500 foot altitude but flight levels could be as low as 500 feet because of weather or to fulfill a request to photograph particular ice targets. Search patterns were adhered to according to prevailing weather and visibility conditions. If visibility was less than 5 nmi, no flight was attempted.

After each flight two sets of output products were produced: a draft list of iceberg sightings by number and/or a written description of pack ice conditions. The iceberg numbering system was consecutive for each flight, and was independent of numbering systems used by other sources. These were sent by telecopier to the participating operators and IDMS immediately after the flight was completed either from the aerial observer contractor's office or from the airport upon aircraft landing. A final copy report (Figures A-6 to A-8) was generated a few hours later which included a map of the rig area, a regional ice map and written details describing the icebergs. These were also sent to the same groups which received the draft copy product earlier.

SLAR ice reconnaissance: A separate aircraft was contracted to provide SLAR imagery and interpreted data products to the operators. The contract was administered by H/BV. The aircraft was a Gulfstream 1 equipped with a Motorola APS94-D SLAR. The aircraft flew at 17,000 feet for pack ice reconnaissance and 14,000 feet for icebergs. Flight patterns were specified by the participating operators, but unlike the visual aircraft, there were no pre-set flight lines.

Flight planning was done prior to each flight according to the ice situtation and the operator needs at the time.

The output products from the SLAR consisted of a quick-look product which was sent to the rigs via HF facsimile directly from the aircraft and contained the results of the first flight line, usually the most critical one. A brief overview was produced as soon as possible after the aircraft had landed and included an analysis of all lines plus the status of each target (usually confirmed or unconfirmed). This product was sent to IDMS and the participating operators' shore bases via telecopier. Several hours later a detailed analysis was produced which was put into an HP 216 microcomputer. Two products were produced from the file of iceberg targets - a cartographic quality map of targets and summary list of iceberg particulars in hard copy and digital format. These two products were also sent to IDMS, the latter via modem. The hard copy products were also sent to the participating operators. Figures A-9 and A-10 show examples of the hard copy products.

Weather forecasts and gridded winds: Each operator had its own service company on contract to produce site-specific weather forecasts. Two of the operators used the same company while the third used another. Each of the two service companies only received data in a direct manner from operators they had a contract with. The rest of the weather observation data from other rigs was taken off the AES circuits. IDMS received the weather forecasts from both companies.

Gridded winds were generated by a service company under contract and were an input into the iceberg and pack ice forecasting models. Figure A-11 shows an example of the gridded wind product. Analyses were provided every 6 hours, forecast winds every 12 hours.

EXTERNAL SOURCES

External data sources included AES Ice Branch, IIP, CCG and the AES Regional Weather Centers. This latter group provided the standard AES marine forecast.

AES/IIP: AES Ice Branch operate an Electra aircraft reconnaissance service on behalf of CCG. They combine visual and SLAR imagery to produce pack ice distribution maps and forecasts of pack ice movement. Iceberg distributions are principally based on an analysis of SLAR imagery with visual confirmation where possible. These data are put into a standard alpha-numeric code which can be accessed by telex (Figures A-14 to A-16). The pack-ice maps are produced in relation to AES flights as well as from other data sources such as satellite imagery. The AES flights for icebergs are controlled by the AES Ice Center and are intended to provide a much larger regional picture than IDMS, which had a strategic and tactical mandate. They also utilize the IIP reports, particularly to define the southern limits of icebergs.

CCG: CCG ship reports were sent to IDMS, the operator shore bases, AES and IIP by telex. For IDMS they only transmitted iceberg sightings reported within a pre-specified area defined by the operators. Once a ship report was received it was checked by CCG to determine if it was in the specified area, and if so, was sent to the IDMS and operator shore bases. Figure A-17 shows a typical CCG ship report.

3.1.3 Communications

The telecommunications network set up for IDMS-85 to handle all data flow to and from the rigs and IDMS are shown schematically in Figure 7 and can be broken down into three main parts for ease of review as follows:

- Land line links
- Offshore/terrestrial radio links
- Communications satellite links

Each of these three parts of the overall telecommunications network is described in detail below. It should be noted that only the land line links were new and dedicated to IDMS. All traffic emanating from IDMS, from the rigs to the individual company base stations, from the

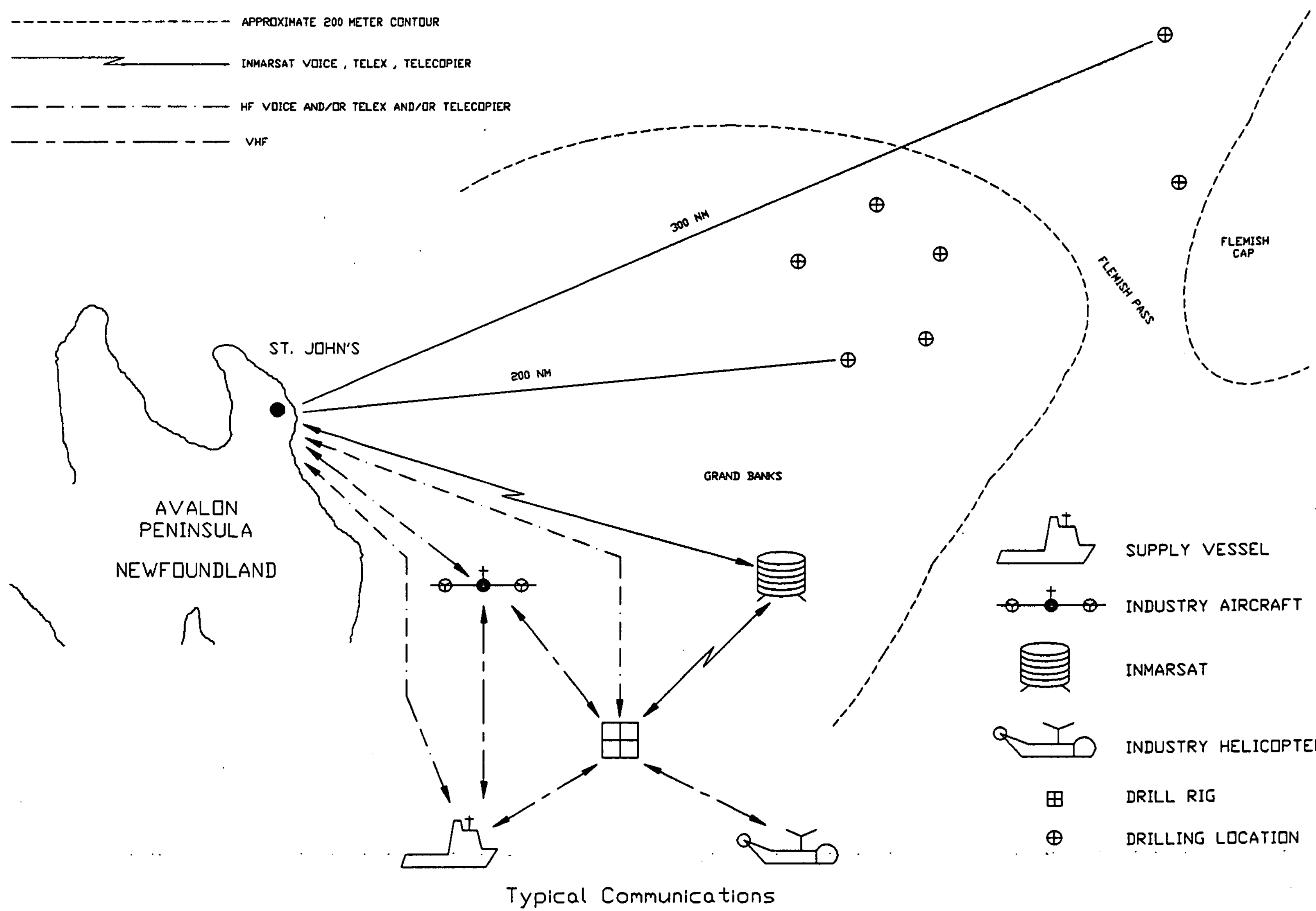


Figure 7. Schematic Layout of IDMS-85 Telecommunications Network

support ships to either the rigs or the base stations, and from all types of reconnaissance aircraft, used the telecommunications network already in place, merely adding to its load.

Land lines: In this context land lines were dedicated telephone lines leased from the local common carrier, Newfoundland Telephone, capable of carrying data in a full duplex mode at a rate of 9600 baud. The installation of these lines was carried out by Newfoundland Telephone who also supplied the Gandalf LDM 419 modems required between each line output and the data terminal.

The 9600 baud lines linked the shore base work station of each operator with the computer facilities near downtown St. John's and also linked the computer with the ice centre at Dobrocky Seatech's facility on Topsail Road, St. John's. In addition to the lines detailed above, the public switched network was used by Dobrocky Seatech to receive or transmit information via telex, telecopier, and telephone from or to the following outside sources:

- AES
- IIP via AES
- CCG
- MacLaren Plansearch Weather Service
- NORDCO Weather Service

Figure 8 illustrates the land lines link.

Offshore/terrestrial radio links: All the rigs communicated to their individual company shore bases via HF radio. This HF radio communication was commonly voice, but included telecopier and telex traffic. Range considerations prevented the use of VHF or terrestrial microwave for rig to shore base communication.

Support vessels and helicopters provided ice reports to their individual rigs via VHF radio link in voice mode. In the event that range or other causes precluded VHF communications between support vessels and rigs, HF communication was used either to the rig or directly to the shore station.

Operator-leased reconnaissance aircraft provided the majority of their reports in hard copy upon landing. However, both VHF communications to rigs and support vessels, and HF communications to the shore bases were used to give real-time information when required.

Communications satellite links: The rigs operated by Mobil, H/BV and PCI had the ability to communicate via the Inmarsat marine mobile communications satellite to their individual shore bases. This communication was in the voice, telex, telecopier or data

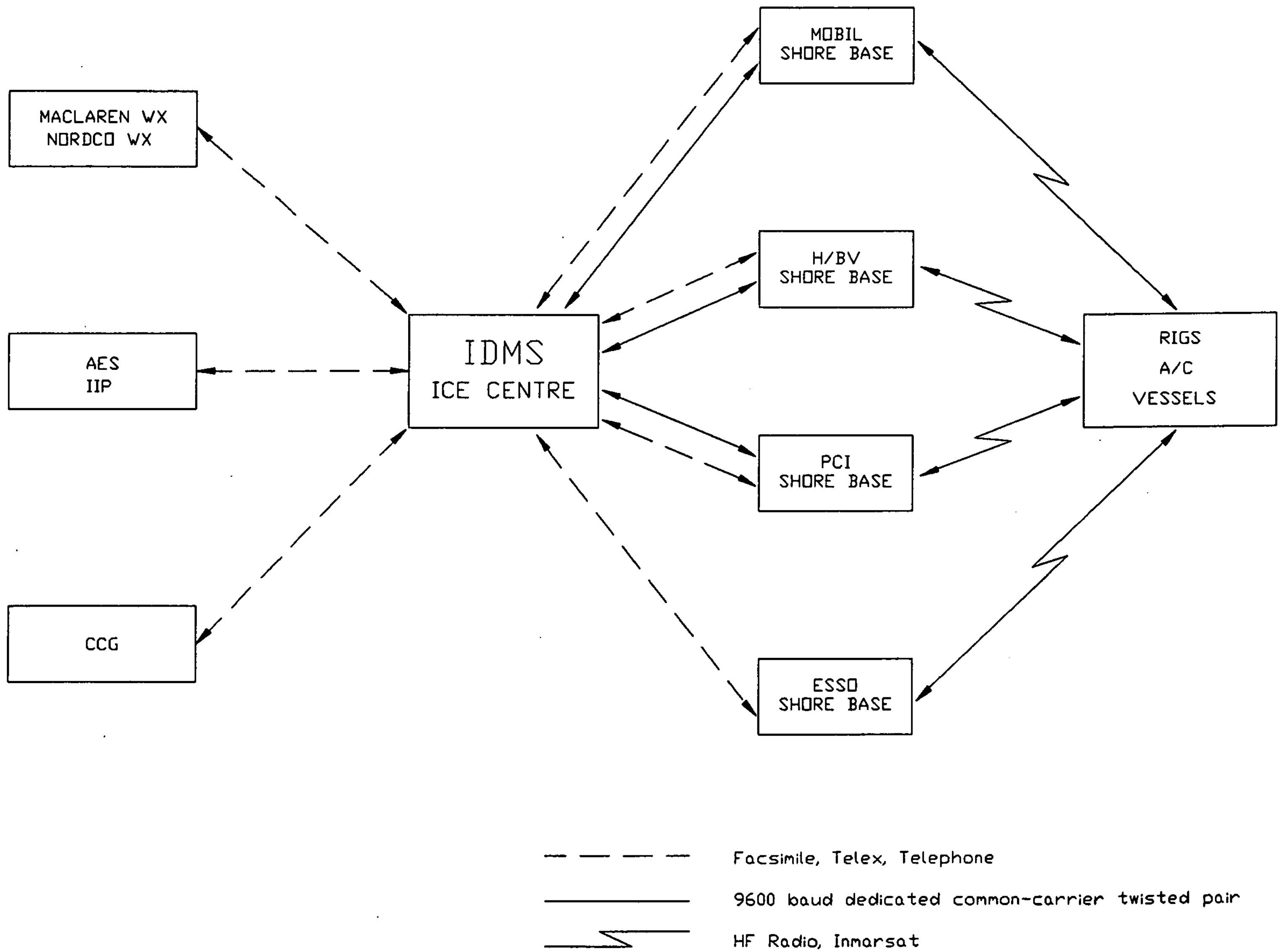


Figure 8. St. John's Network

modes. While providing efficient, reliable, high quality communication, the service was expensive, paid for on a "per unit time" basis, and tended to be used frugally by all users.

3.1.4 Data Management

The primary data management functions of IDMS were to collate the incoming information from the various sources, perform quality control on the observations to finalize the number and location of all active iceberg targets, eliminate duplication of sightings, run forcast models to predict their movements, and produce a set of data products to be sent to the operators, regulatory bodies and other third parties. The output data products will be discussed separately in the next section.

The basic functions of IDMS were developed in response to the Grand Banks Operators' Request for Proposals (RFP). The methods and techniques for performing these duties were for the most part developed by the contractor, Dobrocky Seatech, expanding on the initial system run by NORDCO in 1984.

Level of service and reporting: IDMS operated on three different levels of service as specified in the 1985 RFP. The scheduling of service was as follows:

Level 1 0000-0800 hours local time
Level 2 0000-0800 and 1200-2000 hours
Level 3 0000-2400 hours

Industry dictated the level of service to be provided, which could be changed upon 12 hours notice.

IDMS was required to produce a set of data products, the frequency of which was dictated by the level of service. This set of products comprised the so called "ice status report". On level 1 the ice status report was to be ready by 0700 local time. The report was updated at 1900 local time on level 2 and level 3 service. The main differences between level 2 and 3 were that on the higher level special updates could be requested by the operators at any time on any level of service, IDMS would be made available to provide briefings in the offices of any operator upon request.

At the beginning of 1985, IDMS used one technician per shift; however, later in the ice season, during periods of high data volume, a second technician was added to the shift on level 1 service.

Data manipulation and quality control: The vast majority of the input information was in paper form. The sole exception was the industry SLAR digital data which was transmitted to the IDMS computer. AES and IIP data were digitally coded for communication purposes, but once received at the IDMS centre underwent a quality control and cross-checking with other report sources before any data were finalized.

Assimilating the information from the variety of information sources was primarily a manual process. This involved the manual plotting of the information and undertaking manual quality control procedures, all before entering any data at the computer.

Iceberg position reports from all sources were plotted on a base map after duplicate or dated reports were discarded. Much judgement was exercised in arriving at the final selection of iceberg data, the degree of judgment required was dependent on the source of the observation. Re-identification of targets was the next step in reducing the number of icebergs reported, since some of the new reports could actually be of icebergs already sighted. Re-identification was often a difficult task, especially when there were many icebergs in the vicinity of a given rig.

IDMS set a cut-off time for incoming reports which was one hour before the issue time of the ice status report. The small time gap between incoming information and outgoing products was intended to ensure timeliness of the observations. However during peak loading the cut-off time had to be set two hours before report issue time to handle the volume of data.

Confirmed icebergs were assigned a reference number by IDMS. This number was cross-referenced to the numbering systems in use by each of the rigs and vessels in an attempt to avoid confusion. Attached to each iceberg observation was the time (in hours) since last sighting. Before each reporting period, the operator would review the list of observations from the previous day, and decide whether or not the iceberg should be deleted from the system or maintained. Initially all icebergs were kept on the active file for 96 hours, but this proved impractical since many of the observations became dated and therefore of little operational value. It also contributed signficantly to the duplication of targets since many were resighted by subsequent surveillance but no means of reidentification existed other than by manual means.

Later in 1985 a 48 hour time limit was set whereby icebergs which had not been reported in the previous 48 hours were deleted from the active file. Still later, this rule was relaxed somewhat so that icebergs remained on the active file for up to 72 hours.

Industrial visual and SLAR flights kept their own numbering systems for icebergs. IDMS would cross-reference these icebergs with other sources to eliminate duplication and then assign a new number to those which could not be matched. In the case of SLAR, only visually confirmed icebergs were added to the IDMS system because of the potential of having ship targets in the data set. The totality of SLAR targets were kept in a separate file and depicted in a separate set of data products. Each of the operators viewed the value of SLAR information differently so it was decided to keep this data separate. The same caution was applied to the AES iceberg targets, which were based on a combined visual and SLAR reconnaissance. The concern here was two-fold, 1) to eliminate ship targets in the data set, and 2) to reduce duplication of iceberg sightings.

IDMS received a considerable quantity of CCG ship reports on icebergs. Only those which were visually confirmed by the ship reporting to CCG were entered into the system. A low degree of confidence was placed on many of the reports, mainly related to the positioning of targets. This was due to the poor navigation and positioning systems onboard some of the vessels.

Pack ice edge was plotted manually from combining AES and industry aircraft ice maps onto a base map. A digitizing tablet was used to enter the data. Similar methods were used to plot and enter aircraft flight maps as well as vessel surveillance data.

Gridded wind data were entered into the IDMS computer for the forecast models. This was done twice in an 8 hour shift. The IDMS center also received the site-specific weather forecasts from NORDCO and MacLaren Plansearch. The worst case of the two was used for the weather synopsis.

IDMS had additional manual data manipulations and housekeeping functions to perform:

a) Vessel Status Reports - as at Flight Following Centre, the most recent position and status were entered into a file;

b) Vessel Usage - the calculation of the total number of hours of vessel surveillance and towing used in management by each operator;

c) System Usage - housekeeping of operator rig status to calculate each operator's share of IDMS costs;

d) Hermes Buoy Data - research program of drifter buoy positions sent to IDMS between April and June 1985.

Computer resources: The IDMS center leased computer time on an HP3000 system operated by Information Systems Group (ISG) in St. John's. The computer was accessed by the IDMS center to enter, quality control and archive all relevant data, to generate forecasts of pack ice and iceberg drift, to process and collate data for each ice status report, and to generate data products for archiving and distribution

The products were obtained by suitably equipped operators through remote computer access. Each of the three operators, H/BV, Mobil and PCI had a remote workstation equipped with a terminal, plotter and printer. These were used to create data products based on data stored in the IDMS computer system. These workstations were capable of accessing the ISG computer 24 hours a day, although the products were only updated at the times specified by the level of service.

Forecast models: It was an industry requirement for IDMS to run forecast models of ice and iceberg movement. Simplistic models were developed at Dobrocky Seatech because of a lack of sophisticated models acceptable to all the operators and because other modelling efforts were anticipated through ESRF.

The models used a combination of the real-time gridded wind data and historical current data as driving forces in proportions which varied according to the geographic area. Forecast of iceberg movements were made in one hour increments for up to 48 hours. Sea ice edge was predicted time steps of 12, 24, 36 and 48 hours. Forecast positions were given in range and bearing from specific rigs as well as in latitude and longitude coordinates.

Archiving: The main computer kept a short-term archive of ice conditions which was updated once or twice a day depending on the level of service.

All information which was entered in the computer by the operator was placed into a longer term archive.

3.1.5 Data Products

As mentioned previously, the output data products were available on a 24 hour basis through the remote workstations. A major thrust for IDMS in 1985 was the improvement in the presentation format of the data products. The operators required that map products be designed for cartographic excellence since many of them would have to be retransmitted several times. Especially important was the selection of scale and symbolism to enhance product clarity.

The majority of data products contained a number of selectable or alterable parameters. Maps were produced as colour plots and the range of features which could be added or deleted was menu driven.

The data products which constituted the ice status report were resident on the computer in a computer file which could be accessed by the remote workstation. There were a total of 36 data products broken down into five categories:

Group 1 - Estimated Conditions at Report Valid Time
Group 2 - Forecast Conditions for 48 Hours
Group 3 - Printed Ice Data
Group 4 - Printed System Summary Information
Group 5 - Last Observed Conditions.

Groups 1, 2 and 5 were graphic products . Groups 3 and 4 were printed products.

Each product was labelled with a number and title as well as report number and valid time. Group 1 products were nowcast data which consisted of reports updated to report time by drift forecast models. Group 2 depicted the ice and iceberg conditions forecast for the upcoming 48 hours. The printed ice products included last observed and forecast positions for each active iceberg. Group 4 products included listing of status and position reports from rigs and vessels as well as cost management information. Group 5 products were compiled from the most recent observations.

SLAR products were archived in a separate file for use by each operator as they saw fit.

Within the Group 1, 2 and 5 map products (nowcast, forecast and last observed), there were a total of five different scales:

1. Newfoundland Waters Map (Regional)
2. Grand Banks Regional Map (Strategic)
3. Rig Drilling Area (Strategic)
4. Polar plot - rig centered (Tactical)
5. NE, SE, SW, NW Quadrants of polar plot (Tactical)

Figures 9 and 10 show examples of the Grand Banks regional map and rig site maps. The SLAR products were presented on the same scale formats as products from the "composite" data bases. The operator had the option to expand the scale of any one of these maps and could generate the situation from the perspective of any rig. The ability to alter the scale was a fundamental requirement of the operators.

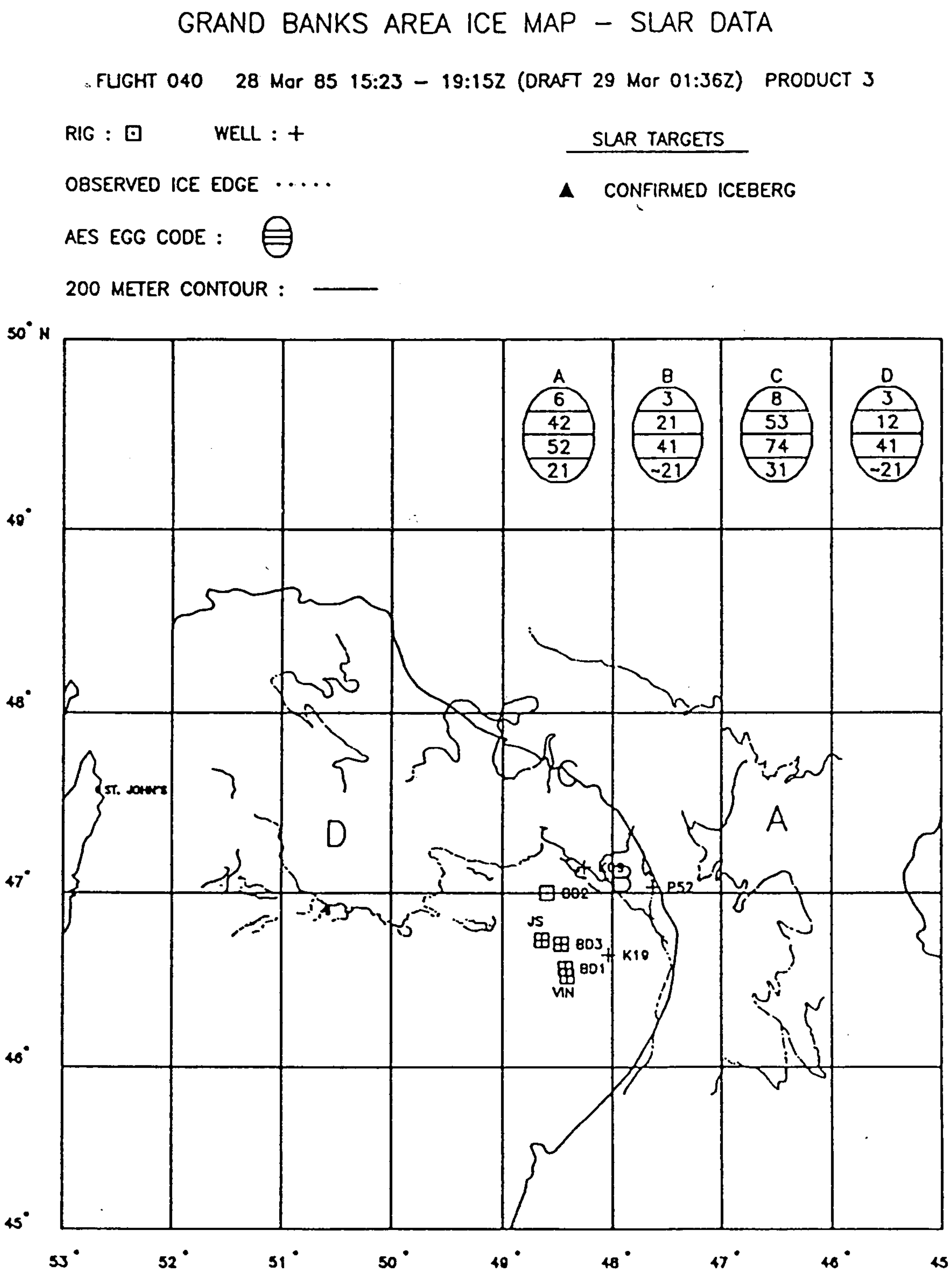


Figure 9. Grand Banks Area Map Product

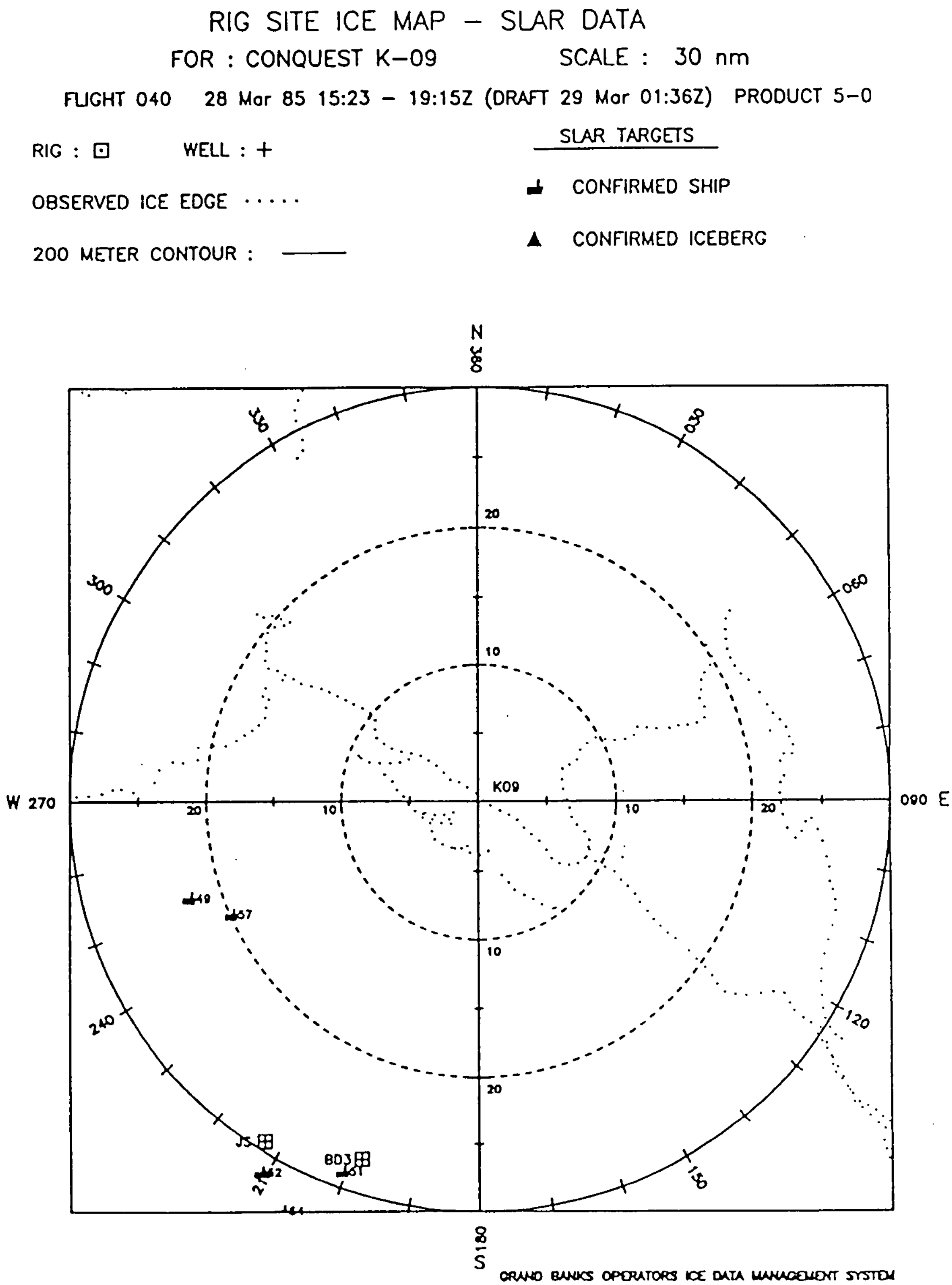


Figure 10. Rig Site Area Map Product

3.2 Assessment Of The Effectiveness, Efficiency And Economy Of IDMS-85

This section discusses the merits and limitations of the components of the IDMS system as it was operated during 1985.

The biggest changes to IDMS during 1985 involved the central facility which received and processed the information and produced the data products. The infrastructure, personnel and procedures for data collection had been established in 1984. This structure closely followed the operators' Joint Ice Management Plan, although there were certain differences in procedure among the operators.

The contract to design and put the facility into place was let near the end of November 1984, and the system was operational by mid-January 1985. IDMS-85 was put into operation under a considerable time constraint. The development of IDMS-85 closely followed the specifications detailed in the RFP. To this end it was generally recognized that IDMS fulfilled the letter of the contract, and it met the basic requirements of the operators and regulators.

In assessing the performance of IDMS-85, it is important to recognize that it was designed to meet a wide spectrum of user requirements. Each operator had its own views on what the system could and should do, and these perceptions were often quite different. This was very dependent on the style of the operator as to how the drilling operation and ice management procedures were performed. The procedures for surveillance and deployment of defence systems against ice hazards were a function of the level of risk each was willing to accept. These factors affected the performance of IDMS, particularly in the frequency and quality of data reporting, as discussed below.

3.2.1 Input Data Sources

The information flow into the central facility as depicted in Figure 6 shows that there were many different sources of data from several observing platforms controlled by several different operators. The IDMS central facility had no control over its data sources. They had no control in where data should be acquired and by what method, and the data inputs were not always received on a scheduled basis. Therefore data was coming into IDMS throughout the 24 hour period in varying quantities which did not always match well with the level of service and the availability of personnel to process the information.

Because of the remote location of the central facility, there was a limited capability for it to communicate with some of the more important data sources, such as rigs and vessels through operator shore base radio rooms. Because of the variability of scheduling of

IDMS service, there was often no one on duty at the IDMS Centre for part of the day and so data sources could not be queried in real-time. Also, the workloads of the IDMS technician, the shore base radio operators, and offshore personnel often made communications difficult and time-consuming. During periods of high data volume, there was insufficient time to query the sources of questionable data. Early in the season, IDMS technicians did attempt to rationalize data by contacting the source, but the practice was seldom used later in the season because of the difficulties in obtaining timely reconfirmation of observations.

In general the data which were passed along to IDMS from the shore base were not quality controlled. This was left to IDMS to perform as part of its regular operation. The operators of course wanted to see the raw data first before sending it to the central IDMS facility. There was no way that IDMS could get the raw input information before the operator did.

From Figure 6 it is quite evident that there was a great degree of redundancy in the information flow within the entire system. For example, SLAR and visual aircraft products were sent to all the shore bases as well as IDMS. The SLAR contractor also communicated quick look products to the rigs while in flight via HF facsimile. A similar degree of redundancy is evident for AES products and CCG ship reports. Thus the shore bases received almost all the information received by IDMS with one important exception - each operator did not receive real-time information gathered by the others, except through IDMS reports and twice daily through voice traffic between rigs and vessels offshore and by telephone conversations between the ice coordinators and phone calls to the IDMS central facility.

Table 2 summarizes the total IDMS data volumes for pack ice, icebergs and weather data used by the IDMS technicians in compiling the ice status reports.

The largest number of hours devoted to ice surveillance was undertaken by industry support vessels, followed by industry visual flights. It is interesting to note how few vessel routing reports were received at IDMS for the amount of surveillance performed. These were obviously given second priority.

Vessels accounted for nearly 47% of all the iceberg reports followed by industry aircraft (visual and SLAR) which made up over 22% of the total.

If the reports from icebergs, pack ice, search areas, vessel routing, vessel status and actual and forecast winds are totalled, there were at least 10,867 pieces of paper to be processed. This number is likely low since many of the reports consisted of two pages or more. Most of this information was manually processed.

Table 2

Total IDMS Input Data Volumes by Source

(January - July, 1985)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	TOTAL
TOTAL NUMBER OF RIG DAYS	10	140	155	139	186	180	138	1040
TOTAL DAYS ON LOCATION	102	16	18	93	173	180	138	720
RIG DAYS BY OPERATOR								
MOBIL OIL CANADA	20	28	31	30	31	30	23	193
PETRO-CANADA	26	56	62	49	62	60	43	358
HUSKY/BOW VALLY	56	56	62	49	62	60	46	402
ESSO	0	0	0	0	31	30	23	84
ICEBERG DATA REPORTS - TOTAL	0	89	247	796	1561	1489	508	4690
VESSEL	0	43	63	249	769	774	295	2193
RIG	0	3	1	196	73	323	163	759
AIRCRAFT	0	31	134	230	450	182	30	1057
OTHER	0	12	49	121	269	210	20	671
SEA ICE OBSERVATIONS (COMPOSITE)	19	29	27	34	20	15	0	144
SEARCH AREA REPORTS TOTAL	25	66	113	232	150	138	72	801
INDUSTRY VISUAL FLIGHTS	17	22	19	31	13	21	3	126
INDUSTRY SLAR FLIGHTS	2	16	13	10	13	10	0	67
INDUSTRY VESSELS	4	24	74	169	112	97	63	543
AES	2	3	10	7	9	3	4	38
IIP	0	1	2	0	3	7	2	15
TOTAL ICE SURVEILLANCE USED (HOURS)	111.7	911.6	1624.2	1704.7	2448.1	2746.7	954.8	10501.8
INDUSTRY VISUAL FLIGHTS	69.4	87.3	76.5	101.1	58.7	98.7	13.4	505.1
INDUSTRY SLAR FLIGHTS	4	34.8	38.9	35.9	62.2	50.2	0	226.0
INDUSTRY VESSELS	31.0	770.0	1430.0	1531.0	2252.0	2527.0	900.0	9441.0
AES	7.3	12.8	72.5	36.7	56.5	20.0	30.7	236.5
IIP	0.0	6.7	6.3	0.0	18.7	50.8	10.7	93.2
VESSEL ROUTING REPORTS	3	11	11	38	51	44	34	192
VESSEL STATUS REPORTS	240	504	558	540	768	720	552	3882
ACTUAL WINDS	80	112	124	120	124	120	92	772
FORECAST WINDS	40	56	62	60	62	60	46	386
LEVEL OF SERVICE								
TOTAL DAYS	20	28	31	30	31	30	23	193
LEVEL 1	20	24	31	13	14	1	0	103
LEVEL 2	0	1	0	12	14	13	23	63
LEVEL 3	0	3	0	5	3	16	0	27

The limitations of each data source regardless of how it is received by IDMS are discussed below. These limitations are important to recognize when discussing the effectiveness of the quality control procedures used by IDMS.

INDUSTRY DATA SOURCES

Rigs: The rig ice reports were produced by the ice observer who also had a number of additional responsibilities, the most important of which was to keep a close watch of the ice situation around the rig. This was primarily accomplished by combining a watch of the radar with visual observation. Many of the observers also did weather observations and current measurements. Their responsibilities also included briefing the rig captain, drilling superintendent and the company representative on the existing ice situation, sometimes up to several times a day on an unscheduled basis. The ice observer also determined the search patterns to be conducted by the vessels in consultation with shore base and the rig captain. For some of the operators the observer was also responsible for receiving vessel ice reports and sending them on to shore base, usually with the help of the radio operator. Thus the observer had a multitude of duties to perform on his 12 hour shift. In interviews conducted with some of the observers, it was quite apparent that the loading of duties including reporting was not difficult when the ice situation was not critical. However when pack ice or icebergs were nearby, the observer became very busy and resulting pressures were substantial. During these times shore base became more demanding for information as did personnel on the rig. A particular burden was the stepped up frequency of reporting required of the rigs and vessels during critical times, which resulted in a large increase in the paper load. Reporting frequency to shore base could increase from every 3 hours to every hour or even every half hour just when the observer was busiest with his other duties.

Each rig assigned its own numbers to icebergs within its area of concern. These were passed along to shore base and IDMS who then assigned each iceberg an IDMS number. This caused some confusion for the ice observer especially for grounded icebergs or ones which the rig knew were there but hadn't recently sent a vessel to file an updated position report. IDMS had the rule which dropped out icebergs which had not been reported for 48 hours. When a vessel was sent by the observer to update a grounded iceberg or other iceberg positions which had been monitored some time ago and the report was sent into IDMS, IDMS would assign the iceberg a new number if the iceberg could not be identified. The new number could be on the next ice status report. This caused confusion because it would seem that there were two or more icebergs when there was really only one observed.

This example points out an important fact about the iceberg reports from the rigs and support vessels - they observed and reported only those icebergs which were of most concern and not necessarily all the icebergs that were in the vicinity. Thus the information

IDMS received from these sources was for the icebergs the rigs were concerned with at the time.

Vessels: Pack ice and iceberg reports from vessels were prepared by the captain or chief mate. There were no extra crew on board for this function, so it was viewed as an addition to their regular duties. The vessels conducted searches according to a pattern set by the ice observer and rig captain. When a new ice target was spotted or detected on radar, the vessel was obliged to stand off and monitor the target to obtain speed and direction data as well as to obtain information on target shape and size. This could be very difficult in dense fog or high wind conditions which precluded some of the data being collected.

Icebergs can also be continually bobbing up and down in higher seas which presents a target with a varying cross-section above the waterlevel. The observer must average the dimensions, and their averages may differ from those of another vessel. Many of the icebergs become unstable and roll over to become an entirely different looking piece of ice. This can often happen several times a day (icebergs can also break up into several pieces). If a vessel was not in the vicinity when these events happened, then the target would be reported as a new iceberg by another vessel or even the same vessel should it revisit the area later. Many icebergs calve growlers which move quickly away from the mother iceberg at speeds of up to several knots. All these situations can and did add to the difficulty of keeping track of all the pieces of ice in the area. It is readily apparent that re-identification of some icebergs can be difficult even for the vessels sent to investigate them. However, the vessel ice report was filed anyway with whatever data that could be practically gathered. The report always included the position of the target estimated using SATNAV and LORAN-C systems. This was considered to be the most reliable part of the information.

The report was sent to the rig or shore base by the chief mate using marine radio. This process could take up to half an hour because of radio traffic, and tie up the mate who might be doing other duties. It is likely that this frustration resulted in the delay of some vessel ice reports and in some not getting transmitted at all to the rig, shore base and ultimately IDMS. These frustrations were aggravated by the increased reporting requirement during critical situations. One of the complaints was that all parts of the report form had to be filled out and given to the rig or shore base at each report time, even when the specifics relating to the berg had not changed. Some of the information transmitted was really a duplication of initial or previous reports which was an inefficient use of vessel personnel and radio time.

There was also unnecessary duplication of vessel search areas by different operators, primarily because of their different styles of operation. An area which had just been searched by a vessel from one operator may be covered by another vessel from a different operator who had a different safety zone with different monitoring procedures. This duplication may have also contributed to an increased number of IDMS targets because the second vessel could produce a different report on the same iceberg. This may have happened for some of the reasons described above relating to the behaviour of the iceberg, but it may also have resulted from a different size and shape estimation from the second vessel. Vessel sweeps ordered by shore base were usually discussed with other operators. Vessel sweeps ordered by the rigs were not always coordinated. They were a response to a perceived threat. Sometimes an iceberg was spotted which was of no concern to one operator, but would be for another. The second operator might then send his vessel to begin continous monitoring. There also arose the situation where there were multiple threats in one area for two or three operators. A one vessel response would not be adequate to protect several rigs, so a number of vessels were sent to begin monitoring and enacting ice management procedures. The frequency of reporting was not always consistent among the operators so IDMS would receive such reports in varying quantity. However for such ice management functions as towing, there was a fair amount of swapping of vessels between operators when critical situations arose and additional or replacement vessels were required.

Visual aircraft reconnaissance: The visual flights were flown as a combination of pre-set flight lines considering prevailing weather conditions and the needs of the individual operators. As the aircraft viewed the icebergs from a different perspective the types of information gathered were different from observations at sea level, particularly with regard to size and shape information.

Each flight used its own sequential numbering system separate from IDMS, the rigs and the vessels. Each target was given a number as it was detected through the flight. Detection capability was a function of prevailing visibility and sea state. Weather conditions limited the effectiveness of any one flight. Sometimes two flights were made in the same day to cover a larger area or to give more effective coverage when weather conditions changed. Visual flights could only be conducted during daylight hours which did not always correspond well with the level of service in IDMS. If the flight was done early in the day, the information would not get into the IDMS system until the next morning's ice status report on level 1 service.

Flights were initiated when there was at least 5 nmi horizontal visibility at the rigs. However this was not always the case over the areas being surveyed which could have better or poorer conditions. Different areas could have differing visibilities which made flights more or less effective. Cloud cover could force the aircraft to fly at a lower altitude so that less area was surveyed. Several flights were conducted in totally obscured cloud conditions while a few others were aborted due to worsening weather conditions. The frequency of flights was tied to weather conditions. However, when the weather was bad and information was needed the most, it could not be obtained by the visual aircraft.

The other limitation to visual aircraft reports was the positional accuracies of the targets. These were visually estimated by the observer and matched against the proposed flight track and aircraft navigation system. If the aircraft was off track as a result of navigation system drift or as a result of a departure from the main track to observe a target more closely, then the positions of the targets could be in error by several miles.

At IDMS, an inaccurate position from an aircraft may have had to be reconciled against a vessel report from another point in time. One of the key factors used in re-identification of iceberg targets was their position in time. If an iceberg was positively identified by a vessel in a certain position with an estimated size, shape and drift speed, this information could be compared to a visual aircraft estimate of position and size taken at a later point in time to determine if the aircraft information was for the same iceberg or another one. If there were many icebergs observed from the aircaft, errors in position could create difficulties for IDMS in comparing the data against that from vessel reports. Vessels tended to track individual icebergs over time, while visual aircraft were more interested in their distribution at a particular point in time.

The information on the icebergs from this source was readily accepted by the rigs, shore base and IDMS because all targets were visually confirmed.

The above comments also apply to targets from helicopter reconnaissance flights except that these were generally limited to flights between St. John's and the rigs and to a limited area of some 50 miles around a given rig.

Helicopters located in the vicinity of a rig tended to hover over each target to get the best possible positioning and size and shape estimates. Flights to and from St. John's did not have time to do this, so their data on position, size and shape were subject to limitations similar to those of the visual aircraft in terms of accuracy.

SLAR aircraft reconnaissance: SLAR flight patterns were set by the operators in conjunction with the aircraft pilots. This aircraft flew at a much higher altitude for pack ice and iceberg reconnaissance to optimize the detection capability of the radar. The higher altitude often precluded the visual verification of iceberg targets which was a major limitation according to some of the operators. The aircraft was used in all weather conditions because of the all-weather capability of the radar which meant that many flights were conducted with undercast cloud conditions. The aircraft was also capable of night time surveillance.

Early in the season the aircraft was flown at night so that the report would get into IDMS and the operators in time for the morning status report and the morning meeting. Later this practice was changed to flights in the afternoon to permit the possible visual reidentification of targets on the imagery.

The SLAR was viewed as an excellent tool for the definition of pack ice edge. However the acceptance of SLAR targets as icebergs, bergy bits and growlers varied considerably between the operators. Some of them would not accept any SLAR targets as real ones unless they were visually confirmed. The debate on targets deduced from SLAR was such that they were treated separately by IDMS at the operators' request with their own numbering system and their own set of data products. Each operator could then access this information separately according to their belief in the information. Some operators found it useful because it was a data set with virtually the same time stamp for every target, unlike the composite IDMS data set which was based on data gathered over several days. The only targets which entered the main IDMS system were those which were classified as confirmed. The ratio of confirmed to unconfirmed targets was very low in general so the impact of SLAR information on the IDMS active iceberg listing was low.

Ice observers on some of the rigs complained that the number of unconfirmed targets on SLAR created a dilemma in deciding on how to utilize their supply vessels for area searches. Some targets which were investigated turned out to be false alarms such as floating debris. The tables of targets also included the location of ships which the observer would have more up-to-date status on in most cases. The limited frequency of these events was not considered as a serious problem by the operators. It would appear that the offshore ice observers had little understanding of the potential of SLAR for iceberg management. It was a relatively new innovation on the East Coast, and some had not worked with it directly or even been exposed to it. There was a need to educate them on its utility.

Similar to the visual aircraft, the production of products from the SLAR aircraft required post-flight analysis. This sometimes took several hours depending on the number of targets detected. Depending on the flight schedule and the level of service on IDMS at the time, the information may have not gotten into the system until the following day or even two days later.

The SLAR could not differentiate between boats and iceberg targets, but this was overcome during the flight by getting all vessels in the area to report their positions to the aircraft. It is not known if all the ships did this all the time so some of the unconfirmed targets could have been ships. By flying a certain amount of overlap between flight lines, slow moving targets could be distinguished from faster moving ones, thus eliminating more ship targets.

The SLAR aircraft was also flown on an irregular basis. When pack ice was the problem early in the season flights were made nearly every day. Later, when icebergs became the primary concern, flights tapered off to around 3 per week. There were stretches of several days when no flights were made.

The chief advantages of the SLAR over the visual aircraft were that much larger areas could be covered in less time because of the wider swath of SLAR. Also, the SLAR aircraft could be flown in any weather conditions.

Weather data: Site specific weather forecasts were received from two contractors working for different operators. A subjective combination of the two forecasts was included in the weather conditions summary in the ice status report, with worst case weather warnings noted. IDMS was not responsible for producing its own weather forecast.

Gridded wind data were received on facsimile twice a day and were manually typed into the IDMS computer before any iceberg or ice drift models were run. This task took the technician up to 30 minutes of an 8 hour shift.

EXTERNAL DATA SOURCES

In general, external data sources were not as frequently consulted and relied upon by IDMS. In some cases the added data would result in more confusion rather than resolving discrepancies. This was due to the fact these data were from different sources not specifically geared to reporting sufficient information which could be used by IDMS to identify icebergs and compare them to those reported by industry sources.

AES/IIP: During the first part of the season observed and current ice charts prepared by AES were assessed by IDMS and combined with industry visual and SLAR sources. The pack ice situation used by IDMS was a composite of the industry and AES sources. It was noted by some of the operators and ice observers that the position of the ice edge was often very different between AES and industry. Much of the difference was likely tied to the timeliness of surveillance and the reliance of AES on forecasting.

Both industry and AES reported pack ice information according to the standard egg code so there was compatability in format. The AES ice charts were used as a cross-check and were a source of information when no industry flights had been made. AES did not fly over the drilling area every day although a current chart produced daily was still generated.

AES commenced dedicated iceberg reconnaissance flights in the winter of 1985. These flights combined SLAR with visual observation and the targets were put into a code also shared by IIP. Unlike IDMS, AES was not interested in tracking individual icebergs. They were more concerned with regional distribution of the number of bergs over a much wider area of concern. IIP covered more southerly areas to define the southern extent of icebergs which was usually well south of the Grand Banks during much of the operating period of IDMS in 1985.

Only icebergs which had been visually confirmed were placed on the active IDMS file.

CCG Ships of Opportunity reports: These reports were received from ships of opportunity by the CCG operations office and sent to IDMS and the operators within 10 minutes of receiving them, if the reported targets were in the area of concern for the operators. The messages were simply transcribed into plain language and sent from CCG by telex at all times of the day.

The biggest complaint about the ships of opportunity reports received through CCG was that they were almost always incomplete for the operators needs and many of the targets were only detected by radar. Many of the ships had notoriously bad navigation systems and unreliable radars which made many of the reports of dubious value to the operators.

Some of the reported positions were in error by as much as 50 nmi, while some of the targets which did get checked out turned out to be floating debris (a dead whale in one case). The lack of more specific descriptive information made it difficult to reconcile these reports with other data.

Efforts were still made to plot the information, although this had to be done manually.

SUMMARY OF FINDINGS

IDMS received data from a multitude of sources, each of which had its own limitations. It was the job of the central facility to reconcile and compare these reports to come up with a stated number of icebergs, bergy bits and growlers that existed each day in and around the Grand Banks drilling area.

Over the season IDMS catalogued a total of 1772 different targets. There is no doubt that this number was much higher than the actual number of bergs observed, in part because of the limitations of the data sources mentioned previously. One measure of the relative importance of each data source was the number of icebergs first sighted by that source. The first sighting was the most critical one, because IDMS had to decide on the basis of the information whether or not the report was for a new target or one previously reported. Table 3 presents the number of different iceberg targets by month and attributes the first sighting to the respective data source. The number of different iceberg targets reached a maximum in May. Industry visual aircraft and vessels were the two most important sources of first sightings followed by industry SLAR. These sources devoted the most time to dedicated reconnaissance and covered the most square kilometers.

A significant number of icebergs were first sighted by rigs which meant that the targets probably could not be reidentified from other sources or the iceberg changed, either from rolling, breaking up or calving growlers within range of the rig. It is also apparent that under some circumstances some icebergs could escape detection by all other means until they came within radar or visual range of the rig. It is most likely however that targets were sighted earlier by aerial surveillance and re-identification was not possible when re-sighted by rigs or vessels.

Table 3

Monthly Summary of Iceberg Reports Sources
into IDMS from all Sources

January to July 1985

MONTH	TOTAL NUMBER OF DIFFERENT ICEBERGS REPORTED	SOURCE OF FIRST SIGHTING								
		RIG	VESSEL	INDUSTRY VISUAL	INDUSTRY SLAR	INDUSTRY HELI-COPTER	CCG	AES	IIP	HERMES BUOY
JANUARY	0	0	0	0	0	0	0	0	0	0
FEBRUARY	70	2	30	26	2	0	10	0	0	0
MARCH	213	1	48	114	0	0	16	34	0	0
APRIL	328	24	40	105	63	4	49	43	0	0
MAY	649	22	174	100	283	18	37	8	0	7
JUNE	418	28	135	111	49	5	79	0	6	5
JULY	94	25	25	11	0	0	15	16	2	0
TOTAL	1772*	102	452	467	397	27	206	101	8	12

*Because of re-identification problems the true total number will be less.

A signficant number of icebergs reported were from AES and CCG ship reports. It is likely that their proportionate share of the total was higher than it should have been. For these sources the input information may not have been sufficient to reconcile these data against industry data previously supplied by AES. This "data recycling" often led to duplication. In the absence of confirming information the system retained duplicate sightings and assigned new numbers to the incoming reports from AES/CCG.

A second measure of the reliability of iceberg sightings by source was to determine which IDMS numbered icebergs had been seen by more than one source. The reliability of detection and reidentification is obviously enhanced if the iceberg had been seen from more than one observing platform. Table 4 lists by month the number of icebergs confirmed by multiple sources and the number of icebergs from each data source that were seen by at least one other. The table includes only those SLAR targets which were entered on the main IDMS numbering system. It is possible and quite likely that a much larger portion of these targets were on the SLAR image but could not be positively identified in relation to reports from other sources. Approximately 15% of the total number were seen by two or more sources. The maximum number of sources which identified a given iceberg was 5.

The highest percentages of icebergs seen by more than one source were those from surface level reports - rigs, vessels and CCG ship reports. This is likely due to more complete information on the shape and size of the iceberg which allowed IDMS to more easily compare and identify multiple sightings. Vessel and rig iceberg reports also had the most accurate position information. However the number of occurrences of multiple sources for icebergs was very low and points out in some measure the success of IDMS in reconciling all the reports from all of the sources. Some of the reasons for this can be attributed to the behaviour of the icebergs in that they can roll or calve between sightings. A certain number also never got reported by another source because they were tracked by only one. This would be the case of a proportion of the vessel ice reports where a single vessel would track an iceberg throughout its drift in the area. If an iceberg was being tracked by one vessel a second vessel had no need to report on it.

3.2.2 Communications

In assessing the effectiveness, efficiency and economy of IDMS/1985, it is convenient to consider the communications aspects under three headings as follows:

- distribution network
- equipment used
- overall communications system design

Table 4

Number of Occurrences of Multiple Sources
For Iceberg Reports to IDMS by Month

MONTH	TOTAL NUMBER OF IDMS ICEBERGS	TOTAL CONFIRMED BY MULTIPLE SOURCES	NUMBER OF ICEBERGS REPORTED FROM MORE THAN ONE SOURCE								
			RIG	VESSEL	INDUSTRY VISUAL	INDUSTRY SLAR	INDUSTRY HELI-COPTER	CCG	AES	IIP	HERMES BUOY
JANUARY	0	0	0	0	0	0	0	0	0	0	0
FEBRUARY	70	8	0	3	3	1	1	0	0	0	0
MARCH	213	3	0	1	2	0	0	0	0	0	0
APRIL	328	52	5	15	15	2	0	14	1	0	0
MAY	649	89	8	33	8	25	6	9	0	0	0
JUNE	418	52	5	22	6	6	1	12	0	0	0
JULY	94	13	2	5	6	0	0	0	0	0	0
TOTALS	1772	217	20	79	40	34	8	35	1	0	0
TOTAL # OF ICEBERGS FIRST SIGHTED			102	452	467	397	27	206	101	8	12

Table 5

IDMS 1985 Iceberg Position Report Sources

February 1985

DAY OF MONTH	LEVEL OF SVC.	RIG STATUS #ON LCN	#OFF LCN	#VISUAL FLIGHTS	#SLAR FLIGHTS	NUMBER OF ICEBERGS BY REPORT SOURCE R	V	E	S	H	C	G	I	B	DT	CT	NUMBER OF ACTIVE ICEBERGS ON IDMS 0730	1930
1	2	5	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2	3	4	1	1	-	0	0	0	0	0	0	0	0	0	0	0	0	0
3	3	2	3	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
4	3	1	4	-	1	0	0	0	0	0	0	0	0	0	0	0	0	0
5	1	0	5	1	-	0	0	0	0	0	2	0	0	0	2	2	2	-
6	1	0	5	1	1	0	0	0	0	0	2	0	0	0	2	4	4	-
7	1	0	5	2	1	0	0	0	0	0	0	0	0	0	0	4	4	-
8	1	0	5	2	-	0	0	-	0	0	0	0	0	0	3	7	6	-
9	1	0	5	2	-	0	0	0	0	0	0	0	0	0	0	7	6	-
10	1	0	5	-	-	0	0	3	0	0	1	0	0	0	4	11	9	-
11	1	0	5	1	-	0	0	0	0	0	0	0	0	0	0	11	9	-
12	1	0	5	1	1	0	0	0	0	0	1	0	0	0	1	12	3	-
13	1	0	5	-	-	0	0	3	0	0	0	0	0	0	3	15	6	-
14	1	0	5	-	-	0	0	0	0	0	0	0	0	0	0	15	5	-
15	1	0	5	1	1	0	0	0	0	0	2	0	0	0	2	17	7	-
16	1	0	5	-	-	0	0	0	0	0	0	0	0	0	0	17	7	-
17	1	0	5	1	1	0	5	0	0	0	0	0	0	0	5	22	9	-
18	1	0	5	-	1	0	6	0	0	0	0	0	0	0	6	28	12	-
19	1	0	5	1	1	0	1	0	0	0	0	0	0	0	1	29	9	-
20	1	0	5	-	1	0	1	10	0	0	0	0	0	0	11	40	17	-
21	1	1	4	1	-	0	1	0	2	0	0	0	0	0	3	43	19	-
22	1	1	4	1	1	0	4	0	0	0	0	0	0	0	4	47	21	-
23	1	1	4	-	-	0	2	3	0	0	0	0	0	0	5	52	11	-
24	1	1	4	-	1	0	1	0	0	0	1	0	0	0	2	54	9	-
25	1	0	5	1	-	1	7	0	0	0	0	0	0	0	8	62	15	-
26	1	0	5	1	1	2	2	0	0	0	3	0	0	0	7	69	16	-
27	1	0	5	1	-	0	10	0	0	0	0	0	0	0	10	79	27	-
28	1	0	5	-	-	0	3	7	0	0	0	0	0	0	10	89	32	-
TOTALS		16	124	21	14	3	43	29	2	0	12	0	0	0	89			

LEGEND

R - Rig
V - Vessel
E - Industry Visual Aircraft
S - Industry SLAR Aircraft
H - Industry Helicopter
C - CCG Ship Reports
LEVEL OF SVC. - Level of Service
#ON/#OFF LCN - Number of rigs on and off location

G - AES Iceberg Reports
I - IIP Iceberg Reports
B - Hermes Buoy Reports
DT - Daily Total of Report
CT - Cumulative Total of Reports

It should be appreciated that all of these factors are to some extent interrelated and had a significant impact upon the overall usefulness of the IDMS.

Communication system requirements, in common with the data gathering, data management and data products aspects of IDMS, were found to be different between the operators using anchored semi-submersible rigs, and Esso who operated a greater distance from the base station in St. John's and used a dynamically positioned rig. Although the basic communications system was similar, the short disconnect time of the dynamic positioning rig, together with the clearly defined and comparatively limited drilling program of Esso, placed emphasis on short term inexpensive solutions rather than the need for more effective but perhaps more capital intensive solutions that could be amortized over a longer period of time. These differences between Esso and the other companies were reflected in their reaction to IDMS.

Below, the results of an assessment of each of the communications subsystems - land lines, offshore/terrestrial radio links, and communications satellite links - are presented under the main aspect headings defined above.

LAND LINES

Distribution network: The landline distribution network used for IDMS consisted of dedicated data lines leased from Newfoundland Telephone. Arrangements were made for the lease of these lines by Dobrocky Seatech. They consisted of unconditioned Schedule 4 Type 4 data channels interconnected between offices on a dedicated (not switched) basis.

Within a given area, the rates for these lines were fixed regardless of distance. The lines between the computer center and all operators' base stations were within the Allandale central office area. The connection between the computer and Dobrocky Seatech involved two central offices. In conjunction with appropriate modems, which will be discussed below, these dedicated lines were capable of a data transmission rate of 9600 baud, and were completely adequate for IDMS-85 needs. The Newfoundland Telephone rates compared very favourably with rates of other telephone companies in Canada and thus the system can be considered to have been both technically adequate and cost effective. Apart from brief initial starting problems corrected within the routine response time of four hours, the reliability of the land lines during the 1985 season was 100%. Thus the system can also be considered to have been reliable.

Equipment used: To interface between data terminals and the data land lines a modem is required. Prior to the installation of IDMS, Newfoundland Telephone did not lease or sell adequate modems for the required purpose. To meet the IDMS requirements of synchronous, high speed modems, Newfoundland Telephone investigated and then supplied, Gandalf long distance asynchronous Model 419 modems. These operated in a completely satisfactory manner throughout the season.

Overall communications system design: In reviewing the land line segment of IDMS communication system alternatives to the approach taken by Dobrocky Seatech were considered. These alternatives were few in number and consisted of the following:

- Lease of dedicated lines from Terra Nova Telephone Co.
- Purchase of modems and connection to either Newfoundland Telephone or Terra Nova Telephone lines
- Use of radio or microwave link rather than land lines

In the reviewing of these alternatives it was considered that as Terra Nova Telephone lines were limited and as far as can be ascertained did service the area near Dobrocky Seatech's facility, the selection of Newfoundland Telephone is considered to have been the appropriate one. From the viewpoint of lease or purchase of the modems, the monthly rate is considered to have been a reasonable one, and in view of the uncertainty of the future of IDMS the decision to lease rather than buy is considered to have been appropriate. Finally, radio or microwave links would have entailed a significant delay in implementation while licenses were obtained, comparatively high capital costs for radio or microwave equipment, and indeed the possibility of not being able to obtain a license due to frequency congestion. Once more the decision to use land lines for the IDMS computer links is considered to have been the appropriate one.

OFFSHORE/TERRESTRIAL RADIO LINKS

Distribution network: The terrestrial radio distribution network used for IDMS by all Grand Banks operators was that in current use for other traffic between the rigs and shore stations, support vessels and rigs, support vessels and shore stations, and reconnaissance aircraft and rigs or shore. All long distance traffic, that is from the rigs, ships or aircraft in the vicinity of the rigs, and shore was via HF radio. Each company had allocated to it approximately 5 HF frequencies used for all traffic. In discussions with radio operators from all four operators, the unanimous opinion was that the HF radio links operate satisfactorily within the framework of their basic propagation limitations, and that by changing from one frequency to another when necessary fully satisfactory communications were obtained. While traffic generally was greater in the ice season, the addition of ice-related voice traffic, while increasing the loading, did not overload the HF communications network. The prime mode of HF communications was voice, though some companies also used HF facsimile, partially in an effort to reduce satellite facsimile costs.

VHF communications between support vessels and rig and reconnaissance aircraft, ships and rigs again is considered to have been satisfactory, with ice-related information providing an additional, but generally acceptable load to the VHF traffic. In addition, when the VHF link was being used in some critical circumstance, such as landing helicopters, both ships and aircraft had HF communications with the rig to fall back on and again found this quite satisfactory.

Equipment used: HF transmitters and receivers used at both base station and rig varied from operator to operator, but were all of common commercial types of single side band, frequency synthesized, equipment. Reliability was high, the equipment was familiar and no complaints were received.

Overall communications system design: The use of HF and VHF communications links for ice data transmission was inexpensive and introduced no additional incremental costs, and could handle the additional load without a negative impact on either ice data or other traffic. This approach did however have some limitations in that Dobrocky Seatech, the operators of IDMS, did not have direct communications with their information suppliers, that is the ice observers, supply vessels and reconnaissance aircraft, when data verification was required. In addition, it would have been difficult, if not impossible, to provide a cost effective low error rate, direct data input to the computer via an HF or VHF link, notwithstanding work by Harris Inc. on commercial HF data links.

COMMUNICATIONS SATELLITE LINKS

Distribution network: All IDMS operators had the facilities on their rigs and at shore bases to operate through the Marisat Maritime mobile communications satellite of the Inmarsat Corporation. This satellite communication system has the advantage of high reliability on a 24 hour basis, distance insensitivity within the Marisat Service area and comparative ease of operation. Inmarsat charges on a "per minute used" basis with the 1985 rate being $12.00 U.S. per minute. With all rigs having been fitted with Inmarsat Earth Stations, it was logical to use the service as part of the IDMS communications system. In particular, the telecopier service was used to provide the inputs from the ice control rig to the shore base, and to distribute the ice data products from individual company shore bases to the rigs. With one exception, which turned out to be an equipment-related problem, reliability was extremely high, and from an operational viewpoint the use of Marisat for both telecopier and voice traffic was very satisfactory. However, the high cost per minute, and the ease of operation encouraging high usage resulted in very high costs for some operators, with one operator reporting a high of over $150,000.00 per month for Inmarsat costs alone. However, given its reliability and ease of use the selection of this approach for the transmission and reception of ice data and ice data products appears to have been warranted.

Equipment used: Standard Inmarsat semi-stabilized platforms and receive/transmit equipment was used with high reliability generally being reported. The exception to this was the PCI facsimile equipment, which proved to be unreliable throughout the ice season. Subsequent work on this equipment identified a detuning problem which was later rectified.

Overall communications system design: In this case the term "overall systems design" is invalid insomuch as use is made of a service already in place. However, there are alternatives, in particular that of the use of the Anik D Canadian communications satellites. With changes in regulations, systems operators will be able to either separately or jointly own their own transmit/receive earth stations operating with Telesat Canada satellites and by either individual or joint use will have the potential for greatly reducing communications satellite costs while maintaining or improving the service received.

3.2.3 Data Management

A key function of IDMS was to receive, collate and reconcile the numerous reports from industry and external sources into a finalized number of icebergs and pack ice edge positions. Despite the limitations of each data source as discussed previously, it was still the job of the central facility to somehow compare these reports, discard the duplicate or more dated ones and come up with a composite picture of the ice situation. The level of effort required to process these reports depended on the prevailing ice situation and the level of service, and the volume of input data.

Pack ice edge information was obtained from AES ice charts coupled with industry aircraft observations and to a much lesser extent vessel reports. Differences were found between AES and industry sources as to the position of the leading edge of the pack, but these were likely due to the differences in the times of observations.

Tables 5 to 10 summarize by month the number of iceberg reports received at the central facility by the various sources available to IDMS. Included in the tables are IDMS levels of service the number of rigs on and off location, the number of industry visual and SLAR flights as well as the number of active icebergs on the IDMS ice status reports. These tables are intended to show the tremendous fluctuations in the number of reports, number of active icebergs and the level of service. There are several interesting trends which are apparent:

1. With the exception of May, industry SLAR was a minor source of iceberg reports (all pack ice reports were used) on the IDMS main system despite the considerable number of flights which were made. This is likely due to the varying level of acceptance of the data by the operators and the low number of confirmed targets.

Table 5

IDMS 1985 Iceberg Position Report Sources

February 1985

DAY OF MONTH	LEVEL OF SVC.	RIG STATUS #ON LCN	RIG STATUS #OFF LCN	#VISUAL FLIGHTS	#SLAR FLIGHTS	NUMBER OF ICEBERGS BY REPORT SOURCE R	V	E	S	H	C	G	I	B	DT	CT	NUMBER OF ACTIVE ICEBERGS ON IDMS 0730	1930
1	2	5	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2	3	4	1	1	-	0	0	0	0	0	0	0	0	0	0	0	0	0
3	3	2	3	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
4	3	1	4	-	1	0	0	0	0	0	0	0	0	0	0	0	0	0
5	1	0	5	1	-	0	0	0	0	0	2	0	0	0	2	2	2	-
6	1	0	5	1	1	0	0	0	0	0	2	0	0	0	2	4	4	-
7	1	0	5	2	1	0	0	0	0	0	0	0	0	0	0	4	4	-
8	1	0	5	2	-	0	0	-	0	0	0	0	0	0	3	7	6	-
9	1	0	5	2	-	0	0	0	0	0	0	0	0	0	0	7	6	-
10	1	0	5	-	-	0	0	3	0	0	1	0	0	0	4	11	9	-
11	1	0	5	1	-	0	0	0	0	0	0	0	0	0	0	11	9	-
12	1	0	5	1	1	0	0	0	0	0	1	0	0	0	1	12	3	-
13	1	0	5	-	-	0	0	3	0	0	0	0	0	0	3	15	6	-
14	1	0	5	-	-	0	0	0	0	0	0	0	0	0	0	15	5	-
15	1	0	5	1	1	0	0	0	0	0	2	0	0	0	2	17	7	-
16	1	0	5	-	-	0	0	0	0	0	0	0	0	0	0	17	7	-
17	1	0	5	1	1	0	5	0	0	0	0	0	0	0	5	22	9	-
18	1	0	5	-	1	0	6	0	0	0	0	0	0	0	6	28	12	-
19	1	0	5	1	1	0	1	0	0	0	0	0	0	0	1	29	9	-
20	1	0	5	-	1	0	1	10	0	0	0	0	0	0	11	40	17	-
21	1	1	4	1	-	0	1	0	2	0	0	0	0	0	3	43	19	-
22	1	1	4	1	1	0	4	0	0	0	0	0	0	0	4	47	21	-
23	1	1	4	-	-	0	2	3	0	0	0	0	0	0	5	52	11	-
24	1	1	4	-	1	0	1	0	0	0	1	0	0	0	2	54	9	-
25	1	0	5	1	-	1	7	0	0	0	0	0	0	0	8	62	15	-
26	1	0	5	1	1	2	2	0	0	0	3	0	0	0	7	69	16	-
27	1	0	5	1	-	0	10	0	0	0	0	0	0	0	10	79	27	-
28	1	0	5	-	-	0	3	7	0	0	0	0	0	0	10	89	32	-
TOTALS		16	124	21	14	3	43	29	2	0	12	0	0	0	89			

LEGEND

R - Rig
V - Vessel
E - Industry Visual Aircraft
S - Industry SLAR Aircraft
H - Industry Helicopter
C - CCG Ship Reports
LEVEL OF SVC. - Level of Service
#ON/#OFF LCN - Number of rigs on and off location

G - AES Iceberg Reports
I - IIP Iceberg Reports
B - Hermes Buoy Reports
DT - Daily Total of Report
CT - Cumulative Total of Reports

Table 6

IDMS 1985 Iceberg Position Report Sources

March 1985

DAY OF MONTH	LEVEL OF SVC.	RIG STATUS #ON LCN	RIG STATUS #OFF LCN	#VISUAL FLIGHTS	#SLAR FLIGHTS	R	V	E	S	H	C	G	I	B	DT	CT	NUMBER OF ACTIVE ICEBERGS ON IDMS 0730	NUMBER OF ACTIVE ICEBERGS ON IDMS 1930
1	1	0	5	1	-	0	2	0	0	0	1	0	0	0	3	3	28	-
2	1	0	5	-	-	0	1	1	0	0	2	0	0	0	4	7	28	-
3	1	0	5	-	1	0	10	0	0	0	1	0	0	0	11	18	26	-
4	1	0	5	1	-	0	4	0	0	0	1	0	0	0	5	23	29	
5	1	0	5	1	-	0	8	3	0	0	4	0	0	0	15	38	27	
6	1	0	5	-	1	0	7	17	0	0	0	0	0	0	24	62	47	-
7	1	0	5	-	-	0	2	0	0	0	0	0	0	0	2	64	41	-
8	1	0	5	1	-	1	0	0	0	0	0	0	0	0	1	65	33	-
9	1	0	5	-	-	0	0	20	0	0	0	0	0	0	20	85	46	-
10	1	0	5	-	1	0	2	0	0	0	1	0	0	0	3	88	39	-
11	1	0	5	1	-	0	3	0	0	0	0	0	0	0	3	91	24	-
12	1	0	5	-	-	0	8	15	0	0	0	0	0	0	23	114	43	-
13	1	0	5	-	-	0	1	0	0	0	1	0	0	0	2	116	44	-
14	1	0	5	-	-	0	0	0	0	0	0	0	0	0	0	116	27	-
15	1	0	5	-	1	0	0	0	0	0	0	0	0	0	0	116	27	-
16	1	0	5	1	1	0	0	0	0	0	0	0	0	0	0	116	27	-
17	1	0	5	1	1	0	0	0	0	0	0	2	0	0	2	118	27	-
18	1	0	5	-	-	0	0	0	0	0	0	3	0	0	3	121	24	-
19	1	0	5	1	1	0	3	0	0	0	0	0	0	0	3	124	9	-
20	1	0	5	-	-	0	0	11	0	0	0	0	0	0	11	135	17	-
21	1	0	5	1	-	0	5	0	0	0	8	0	0	0	10	145	24	-
22	1	0	5	-	1	0	1	4	0	0	0	0	0	0	5	150	28	-
23	1	0	5	-	-	0	1	0	0	0	0	5	0	0	6	156	31	-
24	1	0	5	1	1	0	0	0	0	0	0	2	0	0	2	158	29	-
25	1	0	5	1	1	0	0	4	0	0	0	3	0	0	7	165	19	-
26	1	0	5	1	1	0	2	0	0	0	0	0	0	0	2	167	12	-
27	1	3	2	1	-	0	0	2	0	0	0	0	0	0	2	169	13	-
28	1	3	2	-	1	0	0	30	0	0	0	1	0	0	31	200	39	-
29	1	4	1	2	1	0	0	0	0	0	1	0	0	0	1	201	36	-
30	1	4	1	1	-	0	0	8	0	0	0	0	0	0	8	209	40	-
31	1	4	1	2	1	0	0	0	0	0	0	18	0	0	18	227	52	-
TOTALS		18	137	18	14	1	60	115	0	0	17	34	0	0	227			

LEGEND

R - Rig
V - Vessel
E - Industry Visual Aircraft
S - Industry SLAR Aircraft
H - Industry Helicopter
C - CCG Ship Reports
LEVEL OF SVC. - Level of Service
#ON/#OFF LCN - Number of rigs on and off location

G - AES Iceberg Reports
I - IIP Iceberg Reports
B - Hermes Buoy Reports
DT - Daily Total of Report
CT - Cumulative Total of Reports

Table 7

IDMS 1985 Iceberg Position Report Sources

April 1985

DAY OF MONTH	LEVEL OF SVC.	RIG STATUS #ON LCN	#OFF LCN	#VISUAL FLIGHTS	#SLAR FLIGHTS	NUMBER OF ICEBERGS BY REPORT SOURCE R	V	E	S	H	C	G	I	B	DT	CT	NUMBER OF ACTIVE ICEBERGS ON IDMS 0730	1930
1	1	3	2	2	1	0	2	9	1	0	8	0	0	0	20	20	62	-
2	1	2	3	2	-	0	1	28	0	0	0	0	0	0	29	49	59	
3	2	2	3	1	1	13	25	20	0	0	0	0	0	0	58	107	65	66
4	3	1	4	2	1	6	25	6	0	0	1	8	0	0	46	153	61	57
5	3	1	4	-	1	9	26	0	0	0	1	0	0	0	36	189	50	46
6	3	1	4	2	1	6	11	5	0	0	4	0	0	0	26	215	44	45
7	3	1	3	-	1	2	11	0	0	0	20	0	0	0	33	248	58	52
8	3	2	2	-	-	4	5	0	0	0	0	19	0	0	28	276	54	42
9	1	3	1	1	-	0	3	0	0	0	0	0	0	0	3	279	62	-
10	1	3	1	-	-	19	13	0	0	0	6	0	0	0	38	317	32	-
11	1	3	1	1	-	9	22	0	0	0	0	0	0	0	31	348	12	-
12	1	1	3	2	-	12	6	9	0	0	0	0	0	0	27	375	16	-
13	1	1	3	-	-	10	5	4	0	0	1	0	0	0	20	395	26	-
14	1	2	2	1	-	5	16	0	0	0	8	0	0	0	29	424	19	-
15	1	2	2	1	-	0	7	5	0	0	7	0	0	0	19	443	9	-
16	1	2	2	-	1	1	5	30	0	0	3	0	0	0	39	482	30	-
17	1	3	1	-	-	1	7	0	20	0	3	0	0	0	31	513	38	-
18	1	3	2	1	-	0	3	0	0	0	0	0	0	0	3	516	20	-
19	1	4	1	-	-	0	4	6	0	1	0	0	0	0	11	527	7	-
20	2	3	2	1	-	8	1	0	0	0	12	0	0	0	21	548	16	10
21	2	5	0	-	-	0	8	2	0	0	5	0	0	0	15	563	10	8
22	2	5	0	-	-	1	13	0	0	0	1	0	0	0	15	578	6	6
23	2	5	0	1	-	0	8	0	0	4	2	0	0	0	14	592	7	10
24	2	5	0	-	1	5	4	14	0	0	0	0	0	0	23	615	19	17
25	2	5	0	1	1	30	1	0	30	0	1	0	0	0	62	677	17	32
26	2	5	0	-	-	24	10	0	1	0	0	0	0	0	35	712	35	33
27	2	5	0	-	-	10	1	0	0	0	0	14	0	0	25	737	20	20
28	2	5	0	-	1	8	0	0	0	0	1	2	0	0	11	748	22	8
29	2	5	0	-	-	9	0	0	27	0	2	0	0	0	38	786	29	29
30	2	5	0	1	1	4	6	0	0	0	0	0	0	0	10	796	26	26
TOTALS		93	46	20	10	196	249	138	79	5	86	43	0	0	796			

LEGEND

R - Rig
V - Vessel
E - Industry Visual Aircraft
S - Industry SLAR Aircraft
H - Industry Helicopter
C - CCG Ship Reports
LEVEL OF SVC. - Level of Service
#ON/#OFF LCN - Number of rigs on and off location
G - AES Iceberg Reports
I - IIP Iceberg Reports
B - Hermes Buoy Reports
DT - Daily Total of Report
CT - Cumulative Total of Reports

Table 8

IDMS 1985 Iceberg Position Report Sources

May 1985

DAY OF MONTH	LEVEL OF SVC.	RIG STATUS #ON LCN	#OFF LCN	#VISUAL FLIGHTS	#SLAR FLIGHTS	R	V	E	S	H	C	G	I	B	DT	CT	NUMBER OF ACTIVE ICEBERGS ON IDMS 0730	1930
1	2	5	0	1	1	0	12	2	38	0	3	0	0	0	55	55	40	43
2	2	5	0	1	1	8	6	0	76	0	2	0	0	7	99	154	82	82
3	2	5	0	1	-	2	3	7	0	0	1	0	0	0	13	167	66	16
4	2	5	0	-	-	0	1	5	0	0	0	0	0	7	13	180	21	14
5	2	5	0	1	1	0	3	3	0	0	0	0	0	6	12	192	13	11
6	2	5	0	-	-	0	2	0	1	0	0	0	0	5	8	200	12	12
7	1	5	0	-	-	0	1	0	0	0	0	0	0	0	1	201	12	-
8	1	5	0	-	1	0	1	0	0	0	0	0	0	5	6	207	8	-
9	1	5	1	-	-	0	2	0	3	0	0	0	0	15	20	227	9	-
10	1	5	1	-	1	0	1	0	0	0	1	0	0	20	22	249	10	-
11	1	6	0	-	-	0	1	0	26	0	1	0	0	10	38	287	34	-
12	1	6	0	-	-	0	1	0	0	0	2	0	0	0	3	290	21	-
13	1	6	0	1	-	0	3	0	0	0	2	0	0	15	20	310	10	-
14	1	5	1	-	-	0	0	33	0	0	0	2	0	10	45	355	42	-
15	1	6	0	1	-	0	22	0	0	0	1	0	0	19	42	397	45	-
16	1	6	0	-	1	1	3	16	0	0	0	0	0	10	30	427	25	-
17	2	6	0	2	-	0	69	0	7	0	1	0	0	10	87	514	22	26
18	2	6	0	-	1	0	76	20	0	8	3	0	0	0	107	621	49	55
19	2	6	0	-	1	0	55	0	22	0	0	0	0	0	77	698	43	43
20	3	6	0	-	1	8	94	0	40	0	6	0	0	0	148	846	23	60
21	3	6	0	-	1	3	31	0	33	0	0	0	0	0	67	913	59	62
22	3	6	0	-	-	4	17	1	8	0	17	0	0	0	47	960	55	46
23	1	6	0	-	-	0	14	0	0	0	0	6	0	0	20	980	43	-
24	1	6	0	-	-	1	21	0	0	1	0	0	0	0	23	1003	25	-
25	1	6	0	-	-	3	37	0	0	0	0	0	0	0	40	1043	39	-
26	1	6	0	1	1	7	45	0	0	4	0	0	0	0	56	1099	48	-
27	2	6	0	-	-	17	52	12	25	8	0	0	0	45	159	1258	70	62
28	2	5	1	-	-	11	54	0	0	0	1	0	0	5	71	1329	67	49
29	2	5	1	-	1	3	43	0	17	0	6	0	0	8	77	1406	47	62
30	2	6	0	1	-	0	64	0	0	0	9	0	0	10	83	1489	70	72
31	2	6	0	-	-	5	35	26	0	0	1	0	0	5	72	1561	74	74
		173	5	10	12	73	769	125	296	21	57	8	0	212	1561			

LEGEND

R - Rig
V - Vessel
E - Industry Visual Aircraft
S - Industry SLAR Aircraft
H - Industry Helicopter
C - CCG Ship Reports
LEVEL OF SVC. - Level of Service
#ON/#OFF LCN - Number of rigs on and off location

G - AES Iceberg Reports
I - IIP Iceberg Reports
B - Hermes Buoy Reports
DT - Daily Total of Report
CT - Cumulative Total of Reports

Table 9

IDMS 1985 Iceberg Position Report Sources

June 1985

DAY OF MONTH	LEVEL OF SVC.	RIG STATUS #ON LCN	#OFF LCN	#VISUAL FLIGHTS	#SLAR FLIGHTS	NUMBER OF ICEBERGS BY REPORT SOURCE R	V	E	S	H	C	G	I	B	DT	CT	NUMBER OF ACTIVE ICEBERGS ON IDMS 0730	1930
1	2	6	0	-	1	9	39	0	0	0	0	0	0	0	48	48	72	38
2	2	6	0	-	-	7	47	0	19	0	0	0	0	10	83	131	51	57
3	2	6	0	1	-	15	54	0	0	4	4	0	0	5	82	213	49	52
4	3	6	0	1	-	23	68	10	0	0	2	0	0	5	108	321	55	50
5	3	6	0	1	-	6	56	12	0	0	0	0	0	10	84	405	54	57
6	3	6	0	1	-	1	65	0	0	0	0	0	0	5	71	476	48	32
7	3	6	0	-	-	4	63	0	0	0	1	0	0	5	73	549	32	27
8	3	6	0	1	1	0	53	4	0	0	4	0	0	5	66	615	30	29
9	3	6	0	-	-	0	50	0	1	0	3	0	0	5	59	674	26	30
10	3	6	0	-	1	5	34	0	0	0	5	0	0	5	49	723	21	29
11	3	6	0	-	-	15	4	0	10	0	9	0	0	5	43	766	34	34
12	3	6	0	2	1	22	18	0	2	0	6	0	0	5	53	819	30	22
13	3	6	0	1	-	28	10	28	0	0	4	0	0	10	80	899	17	49
14	3	6	0	-	-	30	12	0	0	0	3	0	6	5	56	955	57	39
15	3	6	0	1	-	26	19	3	0	0	0	0	5	5	53	1008	25	10
16	3	6	0	-	1	18	7	0	6	0	10	0	0	5	46	1054	12	12
17	3	6	0	1	-	14	3	14	0	1	2	0	0	5	39	1093	26	24
18	3	6	0	-	-	10	6	0	0	0	0	0	0	5	21	1114	36	23
19	3	6	0	-	1	14	8	0	4	0	0	0	0	5	31	1145	19	6
20	1	6	0	-	-	2	1	0	0	0	0	0	0	0	3	1148	10	-
21	2	6	0	-	-	11	14	0	0	0	4	0	0	0	29	1177	12	11
22	2	6	0	-	-	14	6	0	0	0	0	0	0	0	20	1197	9	9
23	2	6	0	1	-	12	6	0	10	0	8	0	0	0	36	1233	26	35
24	2	6	0	-	-	6	13	32	0	0	2	0	0	0	53	1286	39	56
25	2	6	0	-	-	4	11	0	0	0	5	0	0	0	20	1306	52	37
26	2	6	0	1	-	6	24	0	0	0	7	0	0	0	37	1343	40	22
27	2	6	0	-	-	3	27	0	0	0	0	0	0	0	30	1373	23	22
28	2	6	0	-	-	8	26	0	0	0	0	0	0	0	34	1407	24	25
29	2	6	0	1	-	7	24	0	0	0	16	0	0	0	47	1454	23	24
30	2	6	0	-	-	3	6	22	0	0	4	0	0	0	35	1489	38	41
TOTALS		180	0	13	6	323	774	125	52	5	99	0	6	105	1489			

LEGEND

R - Rig
V - Vessel
E - Industry Visual Aircraft
S - Industry SLAR Aircraft
H - Industry Helicopter
C - CCG Ship Reports
LEVEL OF SVC. - Level of Service
#ON/#OFF LCN - Number of rigs on and off location

G - AES Iceberg Reports
I - IIP Iceberg Reports
B - Hermes Buoy Reports
DT - Daily Total of Report
CT - Cumulative Total of Reports

Table 10

IDMS 1985 Iceberg Position Report Sources

July 1985

DAY OF MONTH	LEVEL OF SVC.	RIG STATUS #ON LCN	RIG STATUS #OFF LCN	#VISUAL FLIGHTS	#SLAR FLIGHTS	R	V	E	S	H	C	G	I	B	DT	CT	NUMBER OF ACTIVE ICEBERGS ON IDMS 0730	NUMBER OF ACTIVE ICEBERGS ON IDMS 1930
1	2	6	0	1	-	16	23	0	0	0	6	0	0	0	45	45	45	49
2	2	6	0	-	-	6	22	12	0	0	6	16	0	0	62	107	53	50
3	2	6	0	-	-	3	28	0	0	0	1	0	2	0	34	141	42	46
4	2	6	0	-	-	0	19	0	0	0	0	0	0	0	19	160	45	47
5	2	6	0	-	-	5	13	0	0	0	0	0	0	0	18	178	20	19
6	2	6	0	-	-	9	5	0	0	0	0	0	0	0	14	192	10	10
7	2	6	0	-	-	21	8	0	0	0	2	0	0	0	31	223	10	13
8	2	6	0	-	-	12	22	0	0	0	0	0	0	0	34	257	13	16
9	2	6	0	-	-	11	55	0	0	0	0	0	0	0	66	323	16	16
10	2	6	0	-	-	12	21	0	0	0	0	0	0	0	33	356	16	16
11	2	6	0	-	-	13	36	0	0	0	0	0	0	0	49	405	14	17
12	2	6	0	-	-	0	9	0	0	0	0	0	0	0	9	414	17	17
13	2	6	0	-	-	0	6	0	0	0	0	0	0	0	6	420	5	7
14	2	6	0	1	-	0	5	0	0	0	3	0	0	0	8	428	8	7
15	2	6	0	-	-	9	9	0	0	0	0	0	0	0	18	446	6	8
16	2	6	0	-	-	6	8	0	0	0	2	0	0	0	16	462	9	9
17	2	6	0	-	-	4	5	0	0	0	0	0	0	0	9	471	9	8
18	2	6	0	-	-	5	0	0	0	0	0	0	0	0	5	476	4	4
19	2	6	0	-	-	6	1	0	0	0	0	0	0	0	7	483	4	4
20	2	6	0	1	-	2	0	0	0	0	0	0	0	0	2	485	4	5
21	2	6	0	-	-	10	6	0	0	0	0	0	0	0	10	495	6	5
22	2	6	0	-	-	7	0	0	0	0	0	0	0	0	7	502	5	2
23	2	6	0	-	-	6	0	0	0	0	0	0	0	0	6	508	3	2
TOTALS		138	0	3	0	163	295	12	0	0	20	16	20	20	508			

NUMBER OF ICEBERGS BY REPORT SOURCE: R, V, E, S, H, C, G, I, B, DT, CT

LEGEND

R - Rig
V - Vessel
E - Industry Visual Aircraft
S - Industry SLAR Aircraft
H - Industry Helicopter
C - CCG Ship Reports
LEVEL OF SVC. - Level of Service
#ON/#OFF LCN - Number of rigs on and off location

G - AES Iceberg Reports
I - IIP Iceberg Reports
B - Hermes Buoy Reports
DT - Daily Total of Report
CT - Cumulative Total of Reports

2. Reports from industry visual and SLAR aircraft flights often did not get into the IDMS system until the following day's ice status report. This was due to the level of service in relation to the timing of the flights. The time to process the information and get it into IDMS was likely substantial when large numbers of icebergs were spotted. Any delays were crucial to the reconciliation of these reports with those from other sources. The more dated the information the more difficult it was to compare to other, more updated reports. This points to the inability of IDMS to handle data in a continuous, consistent manner.

3. The number of active icebergs on IDMS was highly variable between ice status reports, which was a function of the number of incoming reports and the arbitrary deletion criteria based on age of sighting.

4. The number of Hermes buoys positions reported was a significant portion of the total number of reports received in May and June.

5. The number and timing of industry visual and SLAR flights was highly variable.

DATA MANIPULATION AND QUALITY CONTROL

The number of reports submitted varied greatly amongst the different data sources. Most of this information was received in a paper format which necessitated the IDMS technician to manually collate, quality control and process the information before any computer processing was done. This was perhaps one of the major constraints of the system in 1985. The other major constraint was that the system was not a real-time system. However, it should be stated that 1985 was a worse than average year for pack ice and icebergs. Substantial resources were committed to aircraft flights and "chances" of observing pack ice and icebergs were thus increased. In a year when the ice situation was not as severe, the manual manipulation of data would not have had as much of an impact because there would be less data and therefore more time for quality control.

The manual manipulation of incoming information had a major impact on quality control, forecasting and production of the ice status report. In particular there were several occasions where the ice status report was late because IDMS indicated there was too much information to process and get on to the system in time for production of the products. Incoming reports had to be first plotted on a chart, compared to other reports and observations, and then entered at the computer. Plotting alone was often a very time-consuming process and allowed less time to do a thorough quality control and analysis of the data.

The problem was aggravated by the level of service which was controlled by the operator. IDMS was not always operated on a 24 hour basis, yet data was coming into the central facility at all times of the day. The problem was particularly acute on a level 1 service, when IDMS was only staffed for 8 hours a day. Often a technician would arrive for work to find a substantial pile of paper which he would have to go through, plot the information manually, do a quality control check, run the forecast models and the software to produce the ice status report. The data volume was such that a second technician was added on level l service during peak loading to assist the other in meeting the reporting deadline.

Additional burdens were placed on IDMS which impacted on the duties of the technicians. There were a number of tasks performed which reduced the time available for doing the tasks IDMS was really there to do.

A number of management products were updated and produced on a daily basis. In particular, vessel useage was a product intended to give the operator some idea of hours devoted to ice surveillance. However this calculation was based on the incoming vessel status reports which were not always up to date and accurate. The IDMS technician often had to guess the number of hours as he did not always get those changes in status which occurred between the 4 hourly status reports. Therefore the product produced only approximate information and the effort required to produce the report was yet an additional task which took time away from other, more important tasks.

The number of IDMS assigned iceberg numbers (1772) was far larger than the number of icebergs which were actually in the area during 1985 according to the operators. This large number is due in part to the lack of success of IDMS in iceberg reidentification and eliminating duplicate reports, functions which were partly affected by the time constraints on the technician and the fact that at this point there was limited automated data entry. If the iceberg report could not be reconciled against other received data, then IDMS would assign a new number to the spotted target in question. This was sometimes due to reports being incomplete or because of the possible modes of behaviour of the iceberg discussed previously.

However, it was found that IDMS rarely, if ever, checked observations made by the operator rigs and support vessels. IDMS staff could not contact these sources directly but could have asked shore base to enquire for them. This procedure was probably not done because of the lack of time available to the technician imposed by the multitude of tasks. Part of this problem could also be attributed to the prevailing level of service whereby a vessel or rig ice report sent to IDMS early in the day may not get examined until after midnight if the system was on level 1 service. These early reports may or may not be superceded by others.

IDMS had a number of rules which attempted to overcome some of the iceberg identification problems. In 1984 the strategy was to keep all iceberg reports on the active list even if the iceberg had not been spotted for days. This rule was changed to an arbitrary 48 hour limit whereby all icebergs which had not been reported in 48 hours were dropped. Later this was modified again by extending the limit to approximately 72 hours. There was a problem with the 48 hour rule in that certain icebergs may not get reported again until after 48 hours because they were grounded or not of immediate concern. When the iceberg was later reported the vessel and rig may know it was the same iceberg, but if not informed or unable to re-identify it, IDMS would assign a new number implying there was a new target. There would then be two targets reported by IDMS when there was really only one.

The attempt to find a suitable cut-off time was in an effort to:

a) minimize the duplication problem
b) minimize the loss of good data (still valid) by cutting off the data too soon.

It is evident that a cut-off of 96 hours, 72 hours or 48 hours was too arbitrary. The deletion of targets should have been tied to the surveillance conducted in the area.

Another rule which impacted on the production of the ice status report was that observations received within one hour of the time of the ice status report were to be processed. The intention was to make the information on the products as current as possible. However there was less time to process and quality control these later reports and still get the report out on time. In an effort to alleviate this problem, the operators changed the deadline to two hours before report time so that for the 0730 ice status report, the cutoff time for data entry was 0500 local hours. This points out a shortcoming of the 1985 system in that it could not readily process incoming data. If the data base had been constantly maintained on a near real-time basis no cutoff time would have been required.

The quality control procedure for SLAR information was to enter those targets which had been confirmed as icebergs. All other unconfirmed targets were kept as a separate data base which could be accessed and used by each respective operator. It was the view of some operators SLAR indicated more targets than there actually were, and so to add them all into the main IDMS system would only add confusion. There was little, if any means to quality control the unconfirmed targets because the SLAR covered so much more area than any other source in a relatively short time. The information supplied from the SLAR consisted of a possible identification and position plus the time of observation. This information was considered inadquate to justify the entry of these targets in the main system's "composite" data base.

LEVEL OF SERVICE

A major factor in the effectiveness, efficiency and economy of IDMS was the level of service. Each increased level cost the operators more in daily charges. The number of ice status reports increased from 1 to 2, and the manning of the central facility was increased from 8 hours to continuous 24 hour coverage. The level of service was dictated by the operators. From their point of view it was adjusted according to the frequency of data products which they needed for tactical ice operations. From the contractor's point of view, the level of service dictated the number of shifts available to process the incoming data.

Tables 5 to 10 indicate how variable the total number of reports received at the IDMS central facility could be on a daily basis and how the number of active icebergs fluctuated. The number of reports was compared to the level of service to gauge how much the numbers changed. Table 11 shows the average number of iceberg reports versus level of service summarized by month. The minimum and maximum number are also shown. The numbers indicate an increase in reporting with increased level of service but the variability between minimums and maximums was substantial. Numbers of reports varied also between months according to the number of icebergs which were in the area. Some months there was not many in the area. Some months there was not much difference in reporting between levels of service, particularly levels 2 and 3, but in other months the differences were substantial. Since data was collated and quality controlled manually, the number of reports greatly affected the operations of IDMS, the duties it had to perform and the deadlines it had to meet.

In terms of output products there was really little or no difference between level 2 and 3. There was only one occasion where a special update ice status report was produced by IDMS on level 3 service. Otherwise the same number of ice status reports were produced on both levels. Special briefings on the situation were available at any time to each operator, an option which was not often exercised. From the operators' point of view then, the level of service increase from 2 to 3 did not really increase the output from IDMS although it may have made it more effective because the incoming data was continuously collated, quality controlled and input into the system.

As mentioned previously, problems did occur on level 1 service in part due to the manual manipulation of data, but also in doing a number of additional tasks which were of secondary importance and took valuable time away from the technician. The decision to change from this lower level to a higher one was sometimes delayed by the operators. The contractor sometimes had to notify the operators that the incoming information could not be processed properly without an increase in the level of service with correspondingly more time and technicians to do it.

Table 11

Number of Iceberg Reports Vs Level of Service

Monthly Summary

MONTH	TOTAL NUMBER OF ICEBERG REPORTS	TOTAL NUMBER OF IDMS ICEBERG TARGETS	MEAN NUMBER OF REPORTS AT LEVEL OF SERVICE			MINIMUM NUMBER OF REPORTS AT LEVEL OF SERVICE			MAXIMUM NUMBER OF REPORTS AT LEVEL OF SERVICE		
			1	2	3	1	2	3	1	2	3
JANUARY	0	0	0	0	0	0	0	0	0	0	0
FEBRUARY	89	70	5	-	-	1	-	-	11	-	-
MARCH	227	213	7	-	-	1	-	-	31	-	-
APRIL	796	328	23	27	34	3	10	28	39	62	46
MAY	1561	649	26	67	87	1	8	47	56	159	148
JUNE	1489	418	3	41	58	3	20	21	3	83	108
JULY	508	94	-	22	-	-	2	-	-	62	-

Note that total iceberg reports for May and June include 212 and 105 reports from Hermes drifting buoy positions respectively.

The decision by the operators to change the level of service was a function of the severity of ice in the vicinity of the rigs and its potential threat to drilling operations. Each operator may wish to stay on a higher level of service until the threat has passed or been reduced, or the ice might move on to become a threat to another operator's rig. The second operator in turn desired the increased level of service, thus a higher level of service could be desired for a longer period.

COMPUTER RESOURCES

IDMS was linked to an HP 3000 computer system operated by the Information Systems Group (ISG) of St. John's. The primary functions of the computer were to store the data input by the technician, run forecast models, run software to create the data products and maintain an archive of the information. The central IDMS facility accessed the computer via two 9600 baud land lines, and similar lines existed between the HP 3000 and the remote workstations in the operator shore bases.

Over the 193 days of IDMS operation, the computer was reliable and efficient in its operation. Only two incidents were reported which caused some delay. On April 4 the main data disc ran out of space due to computer operator error, causing a four hour delay in production of the ice status report. The main system disc failed 2 weeks later but a backup system was activated after a 2 hour delay, and the main system was restored within 24 hours. Regularly scheduled maintenance was performed for one hour per day between 12:30 and 1:30 p.m. Users could not access the system during this time.

FORECAST MODELS

As stated in the 1985 RFP, the operators placed little confidence in state-of-the-art models, however forecasting was a requirement. Dobrocky Seatech proposed and implemented simplistic pack ice and iceberg drift prediction models. The system was however configured to accept any model which industry might later wish to use as other development work in modelling was anticipated.

The models were proposed without knowing the error limits of the forecasts. This experience was gained through the season, and periodically the models were adjusted to improve predictions and reduce the error. One major adjustment later in the season was to increase the wind effect for icebergs on the Grand Banks where currents were weaker.

A considerable effort was expended in running these models and evaluating them. However the predictions were still inadequate for the operators. It was recognized that the main intention was to continue development towards achieving a reliable model, but rig based personnel did not all appreciate this fact.

The major impact of forecasting on IDMS was in running the models which required considerable time especially when there were many active icebergs. It is questionable whether the models should have been run on all the active icebergs when there were many of them, especially those which were further away from the rigs. As the ice situation became more critical the sphere of interest for the operators was reduced to those icebergs nearest to the rig. Beyond this range the operators were not really concerned with the icebergs until the critical situation eased and their corresponding area of interest increased. Therefore IDMS might have optimized the use of the models by limiting the forecasts to within a specified range of the rigs which would have saved time and money.

In general the models were not effective in helping the rigs directly, although they did serve as background guidance to the opinions of the observers and shore based personnel. They were used more as an indication of possible trouble.

ARCHIVING

IDMS maintained essentially three types of archives, a short term archive, a SLAR archive and a long term archive. The long term archive included all ice status reports and the data upon which they were based.

3.2.4 Data Products

The major improvement for IDMS in 1985 was in the production and distribution of the data products. This was a major item which was stressed in the 1985 specifications issued by the operators which stated:

> "Data products must be designed for cartographic excellence as certain data products will likely be retransmitted by repeated telecopier transmission to end users. Strict attention must therefore be paid to choice of scales and symbolism to enhance the clarity of products received by end users...
>
> A fundamental requirement of the system will be the ability to alter the scale of any map or circular plot to either present a more detailed view of any area of interest to the operators or to optimize or enhance the presentation format and aesthetics of any data product. Overprinting of data on maps or plots is absolutely unacceptable to the operators".

The format and number of products were specified in great detail in the RFP. From the feedback obtained from the users of the products, these specifications were completely fulfilled by IDMS-85.

A large number of products, 36 in all, were available for each ice status report. The effort required to produce all of them, particularly when much of the incoming data to produce them had to be manually processed, was substantial and occasionally resulted in the ice status report being late. There is a need to rationalize the need and use of the products which will be discussed in greater detail in Section 4. It should also be pointed out that additional products were produced to handle industry SLAR flights.

IDMS produced data products related to three time scales; last observed, nowcast, and forecast. Last observed data was the most recent pack ice and iceberg data reported by industry or external data sources. The age of the data could be hours or days. Nowcast data was an estimate of the ice situation at report time (0730 or 1930 usually), obtained by applying the forecast models to the last observed ice positions and using the environmental data observed in the interim as driving forces. Forecast data was valid for 48 hours, and was derived by applying the forecast models to the nowcast data, using weather forecast data as a driving force.

Because the operators placed little confidence in the forecast models used, greater use was made of data products displaying last observed data than on either of the other types of products.

BRIEF REVIEW OF PRODUCTS

Map products: These were available in five scales for presentation of pack ice, iceberg and areas searched information. Figure 11 illustrates a typical "areas searched" product, which depicted the areas covered by vessels, industry aircraft and AES and IIP aircraft. Each area was defined by the routing of the vessel or aircraft coupled with the prevailing visibility. The areas which had been searched were classified into vessel, air visual and air SLAR and included all areas covered since the last ice status report. This product was considered to be very useful to the operators and the regulators.

The scales at which the maps were produced by the operators depended on which groups within each company received the information and the prevailing ice situation. The one group of map products which was almost never used were the quadrant products. These were covered for the most part by adjusting the scale of the rig site plot.

Tabular printed products: These included iceberg and pack ice data listings, vessel status reports, summary of assigned iceberg numbers, vessel usage for ice management and a summary of system usage. The latter two products were primarily to assist in housekeeping functions. These two products were totally dependent on the reports from the operators. Often the vessel usage had to be estimated by the technician because he had received no reports that a particular vessel had discontinued a particular ice management

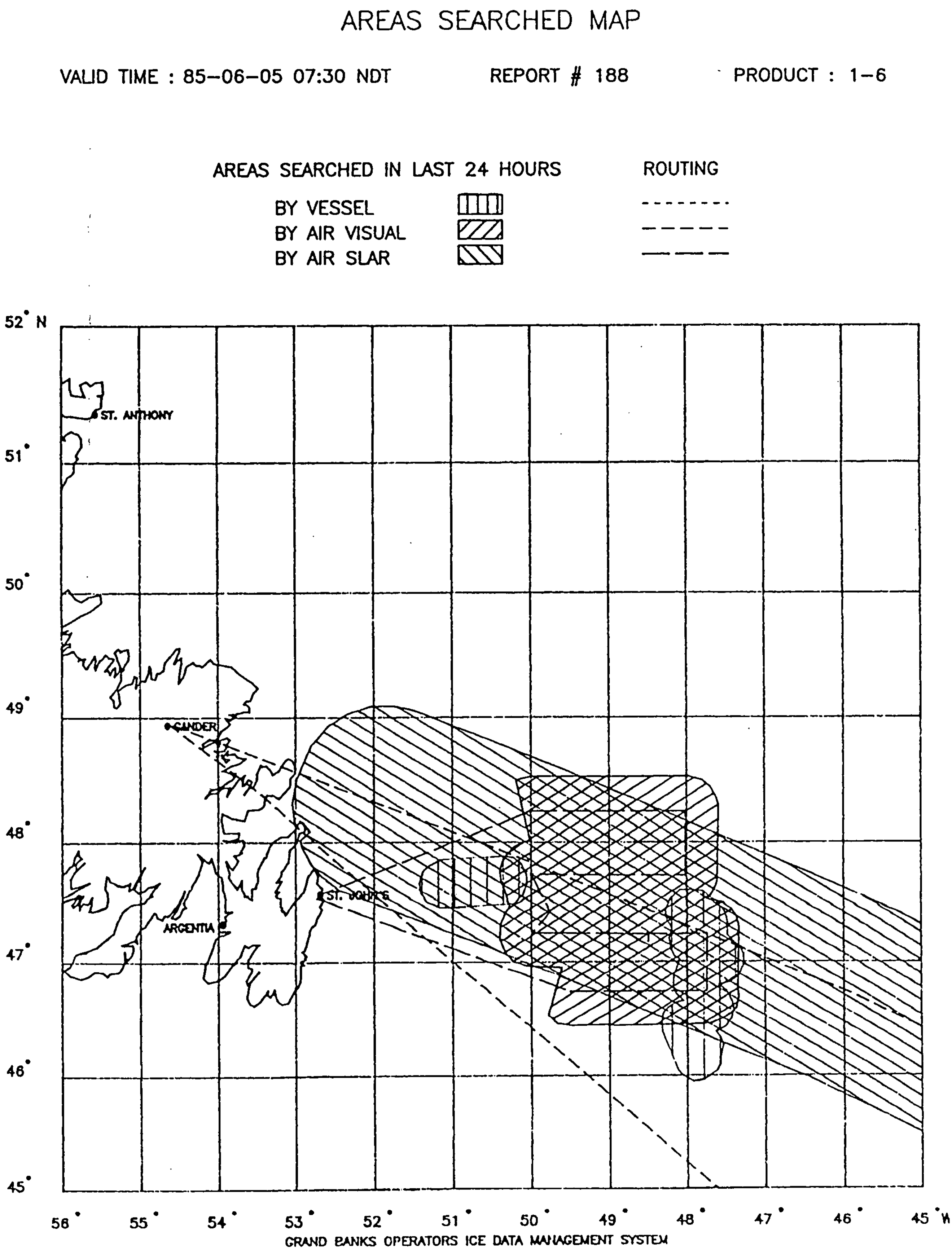


Figure 11. Areas Searched Map

activity. Operators often swapped vessels to perform different functions for varying periods of time. IDMS often had no knoweldge of these arrangements.

The assigned iceberg number product is shown in Figure 12 and presents the IDMS assigned iceberg numbers with those from the operator rigs. The product served as a cross check between IDMS and the rig so that both were talking about the same iceberg. The product was useful for the rig-based ice observers, but sometimes caused confusion for them because of new IDMS numbers assigned to old icebergs the rig-based observer already knew about for the reasons previously discussed.

A vessel status report is shown in Figure 13. The report summarizes the activities of all industry support vessels. This allowed each operator to know once or twice a day what the other operators' vessels were doing. The major complaint was that the product was dated since many of the vessels would have changed their position and status by the time the report was available from IDMS. While this was true for offshore operations, the shore base operators found it a useful update.

The listings of pack ice and iceberg data included nowcast, forecast and last observed data. One of the most popular products was the last observed iceberg data shown in Figure 14. This listing contained position, size, source of observation and hours since last sighting which put the significance of each observation into perspective.

FORMAT AND QUALITY

The map products were produced on colour plotters at the operators' remote workstations. These colour products were useful in clarifying the information for morning meeting purposes, but the end users received the products in black and white because of photocopying or telecopier transmission. The advantages of colour products were limited to those who saw and used the original product.

It was the unanimous view of the operators and regulators that the format and quality of the graphic products was exceptionally good, even when there were many icebergs. This was primarily due to the considerable flexibility built into the software which permitted easy adjustment of scale and cartographic features and in the quality of the hardware which was used in generating plots and printed information. For example, if there were many icebergs in the area the scale could be enlarged to the point where targets were not overprinted on one another and so could be separated to identify individual target positions with respect to the drilling area.

SUMMARY OF ASSIGNED ICEBERG NUMBERS

VALID TIME: 85-07-23 19:30 NDT   REPORT #285   PRODUCT: 3-5
PAGE 1

IDMS	BD1	BD2	706	JS	VIN	710	709
1737	A082	B078	C090	S091	J069	X101	E042
1739	A083	B079	C091	S094	J071	V101	X103
1740	A084	B080	C092				
1742			C095				E042

Figure 12. Assigned Iceberg Number Tabular Product

VESSEL STATUS REPORT

VALID TIME: 85-01-24 07:30 NST

REPORT # 13 PRODUCT: 4-1

VESSEL NAME	CALL SIGN	OPER CO	LAST REPORT LATITUDE	LONGITUDE	TIME	STATUS
MAHONE BAY	VXGB	H/BV	46 59.0N	47 37.0W	24/0730Z	STAND BY SEDCO 706
PLACENTIA BAY	VCYQ	H/BV	47 34.2N	52 40.9W	24/0730Z	SNF PIER 2
CHIGNECTO BAY	VXJK	H/BV	47 28.3N	51 50.6W	24/0730Z	ETA SEDCO 706 1800 NST/24
BONAVISTA BAY	VXJG	H/BV	46 59.0N	47 37.0W	24/0730Z	SEDCO 706 ANCHOR HANDLING
TRINITY BAY	VXJF	H/BV	46 42.0N	48 00.0W	24/0730Z	STAND BY BOW DRILL 3
GABARUS BAY	VCYS	H/BV	47 17.0N	49 58.0W	24/0730Z	ETA SEDCO 706 1100LT/24
ARCTIC SHIKO	VCBQ	H/BV	47 12.0N	48 15.0W	24/0730Z	STAND BY BOW DRILL 2
OFFSHORE TRADER	4296	H/BV	47 34.2N	52 40.9W	24/0730Z	SNF PIER 27
OFFSHORE HUNTER	2329	H/BV	47 34.2N	52 40.9W	24/0850Z	DEPARTING FOR BD1 - ETA 1900
BOLTENTOR	VOFF	MOCL	46 40.0N	48 42.0W	24/0930Z	STANDING BY JOHN SHAW
NEUTOR	VODZ	MOCL	47 34.2N	52 40.9W	24/0930Z	PORT SNF
SCHNOORTURM	VOCC	MOCL	46 40.0N	48 42.0W	24/0930Z	STANDING BY JOHN SHAW
S'FRTH ATLANTIC	VCBL	PCI	46 30.0N	48 25.0W	24/0730Z	STAND BY BOW DRILL 1
BALDER CABOT	GBXQ	PCI	46 30.0N	48 25.0W	24/0730Z	STAND BY BOW DRILL 1

Figure 13. Vessel Status Tabular Report

LAST OBSERVED ICEBERG DATA

VALID TIME: 85-05-25 07:30 NDT

REPORT #168 PRODUCT: 3-1

BERG #	LAST SIGHTED	OBSERVED LAT/LONG	SIZE SHAPE	LENGTH (m)	WIDTH (m)	HEIGHT (m)	DRAFT (m)	SOURCE OF OBS	HOURS SINCE SIGHTING
1083	85-05-25 0530Z	47 34.4N 47 38.6W	U U	U	U	U	U	VESSEL VXGB	4
1082	85-05-25 0530Z	47 39.5N 47 48.9W	U U	U	U	U	U	VESSEL VXGB	4
T0974	85-05-25 0530Z	47 33.1N 47 49.4W	MB PNC	E 40	E 25	E 13	U	VESSEL VXGB	4
1012	85-05-25 0530Z	47 44.4N 47 46.8W	MB DDK	E100	E 50	E 25	U	VESSEL VXGB	4
1080	85-05-25 0530Z	47 29.6N 47 45.6W	U U	U	U	U	U	VESSEL VXGB	4
1081	85-05-25 0530Z	47 28.3N 47 41.4W	U U	U	U	U	U	VESSEL VXGB	4
1079	85-05-24 2000Z	48 21.9N 45 47.0W	LB U	U	U	U	U	709 RADAR	14
1078	85-05-24 1900Z	48 00.1N 46 55.7W	SB U	U	U	U	U	709 RADAR	15
1077	85-05-24 1900Z	48 05.2N 47 01.1W	LB U	U	U	U	U	709 RADAR	15
1075	85-05-24 1320Z	49 59.8N 48 40.5W	MB DDK	E 60	E 20	E 20	U	VESSEL VCGM	20
1076	85-05-24 1340Z	48 00.3N 48 38.9W	SB DDK	E 12	E 6	E 6	U	VESSEL VCGM	20
1074	85-05-24 1300Z	47 59.5N 48 39.5W	SB SPH	E 35	E 20	E 9	U	VESSEL VCGM	21
1073	85-05-24 1245Z	47 58.8N 48 38.8W	SB WDG	E 15	E 10	E 8	U	VESSEL VCGM	21
1072	85-05-24 1215Z	47 56.8N 48 41.0W	MB PNC	E 40	E 40	E 35	U	VESSEL VCGM	21
1071	85-05-24 1135Z	47 57.1N 48 47.5W	SB TAB	E 20	E 10	E 5	U	VESSEL VCGM	22
1070	85-05-24 1045Z	47 49.4N 48 53.5W	LB DDK	E 75	E 50	E 50	U	VESSEL VCGM	23

T=UNDER TOW, X=GROUNDED U=UNKNOWN M=MEASURED E=ESTIMATED S=WATER DEPTH
N=NUMEROUS TARGETS (#)

Figure 14. Last Observed Iceberg Tabular Data Report

METHODS OF DISTRIBUTION

Data products were produced in the central IDMS facility and at remote workstations located in the shore bases of H/BV, Mobil and PCI. Esso received a specified set of products delivered by telecopier.

The remote workstations worked well according to the operators. A few difficulties were initially experienced with the plotters but these were mainly related to using the pens and glossy paper. The instructions for producing the products were well laid out and explained, and service was prompt for any difficulties experienced. The technicians at the shore bases experienced some time-sharing delays when accessing the system to produce the data products. This delay was from multiple users producing products at the same time.

One of the major tasks of the workstation operator was to reproduce and collate subsets of the data products for distribution to various groups within each company. When the number of active icebergs was large, there were a large number of pages making up the report. All these pages had to be reproduced in varying quantities and distributed in time for morning meetings. If the report was late this left less time to produce the original products and to reproduce and distribute them. Therefore the timely arrival of the ice status report was crucial.

IDMS also distributed reports to the regulator authorities - COGLA St. John's and NLPD - via telecopier. The products comprising these reports were determined by the operators. AES Ice Branch received products through COGLA St. John's five days a week.

In the view of the operators, the distribution of a subset of the data products to the regulatory authorities was an important function of IDMS. The IDMS products fulfilled the daily requirements of these agencies which meant that for the most part the operators could carry on their own work without the additional task of creating individualized products. Of course if the situation did become critical the regulator was free to ask for, and did receive more up-to-date information. Therefore the data products were effective in meeting the needs of the regulators.

There was general satisfaction with the remote workstation method of distributing the data products, because each operator could create them to suit their own specific requirements for presentation and format and they could be generated on their schedule. The workstation added costs for leasing the hardware and the communication links but in the view of the three operators, it was worth the expense. Esso did not lease a remote workstation, primarily because of the expense versus a very short drilling program and the lower amount of information they would receive for their operating area which was geographically removed from the other operators.

ROLE IN OPERATIONS

Although the data products could be accessed at remote workstations by suitably equipped users at any time of the day, they were updated only once or twice a day depending on the level of service. Consequently their role in daily operations was more for providing a regional and strategic perspective rather than for tactical support. The 1985 system did not and could not meet the tactical needs of the operators, although there was a recognized need for IDMS to fulfill a more tactical role. It is clear that such a role for IDMS would have significantly affected the number, format and frequency of the products.

The primary thrust of the IDMS data products during 1985 was to provide observed and forecast pack ice and iceberg information on a regional scale and on a strategic and tactical scale, within the limits of system design. The products allowed each operator to know once or twice a day what the other operators were doing and seeing. A subset of the data products was sent to the regulatory authorities to help fulfill their operational and safety audit functions. Thus the products were specified, designed, produced and distributed to satisfy a wide number of different users within each operator as well as to other regulatory and third party interests.

Perhaps the most important role for the products was as reference material for the morning meetings held by each of the operators. The products were produced in various packages and sent to the different departments within the company in time for this morning briefing. The meeting was held amongst all groups involved in some aspect of the drilling activity as an information exchange early in the working day. The ice report, and perhaps an interpretation by the ice coordinator, his assistants, or a briefer from IDMS was part of the daily briefing session and helped in planning the daily activities at the rig and in initiating any longer term ice management activities such as vessel surveillance, sweeps or aircraft reconnaissance flights.

The IDMS products were of less importance to the rig because the information was almost always dated. Most of the information was already known at the rig except for icebergs and pack ice outside their area of interest. However IDMS did provide a central role in the identification and numbering of iceberg targets. The summary of assigned iceberg numbers was the product which attempted to correlate rig based observations (including those from vessels) with those from other industry sources. IDMS was not always successful in achieving a match, but it was attempting to permit the rigs and vessels to talk about the same targets since each rig had its own unique numbering system. While this was one of the desired goals of the system, it was clear that it did not fully succeed at times which occasionally resulted in confusion at the rig and may have led to some additional vessel searches. When such situations occurred, the confidence of rig personnel in IDMS was lowered and its credibility suffered.

3.3 Summary and Conclusions

IDMS-85 successfully met the basic requirements of the operators and regulators in providing a regional and strategic picture of ice conditions in the drilling area through the use of high quality data products. The system fully met the specifications of the operators in their 1985 request for proposal. IDMS did not meet the operators' tactical requirements because it was not a real-time system.

Below are listed the conclusions and summaries of the performance of each component including input data sources, communications, data management and data products.

3.3.1 Input Data Sources

1. There was a large degree of redundancy in data reporting between a number of the sources, the shore bases and IDMS. In particular industry visual, and SLAR data as well as CCG ship reports were received at shore base at the same time as IDMS.

2. There was no quality control of rig and vessel ice reports at the shore base. The information was passed through to IDMS. The ice coordinator only used the raw data until IDMS reports were delivered because it was quicker.

3. IDMS had no easy facility to check on vessel or rig reports and did not have control over its data sources. Thus it was dependent on timely and accurate reports to come up with the most accurate picture. In general the frequency, scheduling, quality and quantity of incoming reports was highly variable and would sometimes overload the system.

4. Each data source had its limitations related to weather, sea state and the sometimes peculiar behaviour of icebergs. The reporting forms were sometimes a source of frustration because of the paper load and the amount of competing radio traffic which delayed ice information getting through in a timely fashion.

5. As the ice situation became more critical, there was a greater need to know more frequently what the ice situation was. Thus reporting requirements increased with an accompanying increase in paper load.

6. There was obviously a great deal of effort and expense involved in monitoring the Grand Banks area in 1985. This was accentuated by a severe ice year both in terms of pack ice and icebergs.

7. All observations made by vessels, aircraft and rigs were subject to the drift and breakup patterns of the ice and icebergs. Icebergs were frequently observed to roll over, break-up and calve growlers, particularly towards the summer months when ice deteriorates. Unless a vessel or aircraft happened to observe the iceberg when these events occurred, re-identification of targets as well as the identification of new ones was very difficult.

3.3.2 Communications

Generally speaking the overall communications system for IDMS/85 operated satisfactorily from a distribution network, equipment and spectrum usage viewpoint. However, the system was cumbersome to use from the viewpoint of the ice observer and the radio operator requiring considerable time to send the iceberg data, and to distribute the incoming observation data for rigs and vessels received by facsimile. In addition, payments to Inmarsat for the use of the Marisat Maritime Mobile Satellite for telecopier and voice services were extremely high causing, in a number of cases, cost reduction schemes to be put into force. It can be concluded that given the circumstances at the time, the 1985 communications system was the logical selection and with the exception of the Marisat charges was cost effective, but inefficient in the use of ice observers' and radio operators' time.

3.3.3 Data Management

1. Incoming data was manually collated, quality controlled and then entered on to the computer system. This manual process was very time consuming and took up much of the technician's time. Much of the time was simply spent plotting data and reconciling the reports before re-identification could be done. The manual plotting of information left less time to do the needed cross-checks to eliminate duplicate reports.

2. The manual task of entering data and the time it consumed was aggravated by processing of additional data which under contract were secondary functions of IDMS. These tasks included input of vessel status and vessel useage information which in itself was sometimes inaccurate because of swapping of vessels between operators. Those tasks were done manually and competed for time with other more important duties.

3. IDMS was not entirely successful in reconciling duplicate iceberg sightings. This caused an overestimation of the actual number of icebergs sighted. Part of the problem was related to arbitrary procedural rules within IDMS to eliminate old targets, but there was also the limitation of the vessels themselves in reidentifying or consistently reporting specific targets.

4. The three levels of service did not match well with the operators' need to obtain information and the contractor's ability to process the information. There was essentially no difference between level 2 and 3 service in terms of output since the number of scheduled ice status reports remained the same. However the increased level allowed round-the-clock staffing of the central facility (i.e. the main intent of level 3 service) which led to a more efficient operation since the situation could be continuously monitored. The real question related to how much data was processed in a given period of time. If the data manipulation process had been more automated it is probable that the amount of data processed, and the quality of processing, would have been more acceptable.

5. Forecasting was a major activity at the central facility, but the results were less than favourably received even at the operating level. Forecast on all icebergs were generated for each ice status report, a process which involved considerable time and was not always necessary. Some rationalization of icebergs to be forecasted was needed and but was not specified by the operators. The aim should have been to optimize and minimize the processing requirement.

3.3.4 Data Products

The efficiency, effectiveness and economy of the data products was one of the major improvements to IDMS in 1985. The review of the data products and discussions with the users both onshore and offshore can be summarized, and concluded by the following points:

1. The IDMS products fully met the specifications for presentation, quality, clear format and flexibility as specified in the 1985 IDMS RFP.

2. Colour graphics were really only useful for those users which received the originally produced product. All others received black and white versions through reproduction and/or telecopier transmission.

3. There is a need to rationalize the use of the products to determine which are most used and which could be dropped or merged with other products. For example, a reduction in the number of iceberg forecasts could considerably reduce the paper output volume.

4. The remote workstation was an effective and efficient means of distributing the data products. It allowed the user to create his own tailor-made reports on his own schedule after the ice status was updated. The workstation and communication lines were expensive but were considered to be worthwhile.

3.3.5 General Conclusions

One final question needs to be answered;

> "Did IDMS-85 meet the objectives and mandate specified by the regulators and developed by the operators?"

The answer is partly yes and partly no. The following general conclusions can be made:

1. IDMS met the basic requirements of the regulators who wanted and received daily updated products and forecasts. The products were successful in providing the regulators with useful and relevant information in a suitable format and presentation. It provided products which allowed each industry operator to view the collective ice situation, which is the essence of joint ice management.

2. IDMS products fulfilled the regional and strategic needs of the industry operators most of the time. It did not meet the tactical, more real-time requirements because it was not set up to do so.

3. There is an urgent, continuing need to improve the forecasts. Both operators and regulators recognize the need for improvement. In 1985, forecast products were used only as guidance material. More accurate forecasts would be used to a greater extent in planning of operations.

4.0 ANALYSIS OF USER REQUIREMENTS AS STATED IN 1985

The second task of the study was to conduct a user survey of industry participants, regulatory agencies and third party interests to clarify and rationalize needs for pack ice and iceberg information, as stated by participants in the 1985 system.

When the study was originally planned, it was anticipated that questionnaires would be drafted and circulated to users and other interested parties, and meetings held with groups of users to obtain their views as to future needs. Interviews carried out during the first task of this study indicated that this approach was unlikely to be most effective. The range of participants and interested parties interviewed during the first phase was therefore increased, and the topics and questions asked extended to include present concerns, and perceived needs for the future. By using a one-on-one approach, and combining the questioning regarding future needs with discussion of the effectiveness of the 1985 system, it is considered that a more accurate appraisal of user needs was obtained.

In planning the interviews two main interview tools were devised. The first of these was the IDMS 1985 Product Matrix, consisting of a listing on the Y axis of Ice Data Products available during the 1985 season from IDMS, against an X axis of questions relating to the usefulness, timeliness and effectiveness of each product. An example of this matrix, including an "aide memoire" sheet of explanation to the user regarding the ice product matrix is shown as Appendix B. This interview tool was used primarily to gain information on data flow and the usefulness of data provided. The second interview tool was a list of communications interview guidelines designed to define the communications information required, and for use as an interviewer checklist to ensure that all information had in fact been received. These communication interview guidelines are attached as Appendix C. As a final stage of interview planning, a list of required interviews was prepared. The list is presented in Table 12. The intent was to meet with various levels of personnel from the active operators as well as to meet with additional industry and government personnel who are presently involved or could be in the future.

In addition to the meetings and interviews combining inputs for both the first task in the study and this task, a number of additional interviews were conducted, both in person and by telephone. These were primarily with potential suppliers and service organizations typified by Telesat Canada, Grove Communications Limited and the AES Ice Centre.

The study also considered user requirements for the future, when offshore drilling activity moves into the production phase. This scenario will affect 1985 ice information requirements, in that the introduction of new systems such as shuttle tankers and different offshore platforms will most likely need additional types of information on perhaps a different schedule. Offshore oil production will also alter the baseline requirements since there will be a continuing, long-term presence of one or more industry operators.

Table 12

List Of Interviews By Organization

ORGANIZATION	GROUP
Dobrocky Seatech Ltd.	1985 IDMS Architects/Operators
FENCO Newfoundland	Visual Aircraft Ice Observers Rig Ice Observers
F.G. Bercha and Associates Ltd.	SLAR Operator
NORDCO Ltd.	1984 IDMS Architects/Operators Weather Forecasters Rig Ice Observers
Mobil Oil Canada, Ltd.	Ice Coordinator Shore Base Radio Operator Rig Radio Operator Vessel Captain(s) Environmental Manager Rig Captain(s)
Petro-Canada Inc.	Ice Coordinator Assistant Ice Coordinator Shore Base Radio Operator Vessel Captain(s) Drilling Manager Rig Captain(s)
Husky/Bow Valley East Coast Project	Ice Coordinator Assistant Ice Coordinator Shore Base Radio Operator Drilling Manager Vessel Captain(s) Rig Captain(s)
Esso Resources Ltd.	Ice Coordinator Environmental Coordinator

CCG - St. John's
AES Ice Branch - Ottawa
COGLA - St. John's
COGLA - Ottawa
Newfoundland & Labrador
Petroleum Directorate

Newfoundland Telephone
Grove Communications Ltd.
Polestar Communications Ltd.
Telesat Canada

Ice Operations Officer
BAPS, Forecasting

User requirements must be placed in the total context of the future east coast ice surveillance program which includes the AES Ice Branch. AES routinely conducts an ice and iceberg surveillance program off the east coast of Canada.

A full list of persons interviewed, and addresses, is contained in Appendix D.

4.1 Statement of User Requirements

It should be kept in mind when reviewing these user requirements that to carry out operations during the winter months, the operators, in addition to reporting for operational reasons, are obligated to report ice information in some form to the regulators, as per drilling regulations and guidelines. The operators are also obligated to report iceberg information under the Internation Convention for Safety of Life at Sea (SOLAS), which in Canada comes under the jurisdiction of CCG. This convention was signed by more than 100 countries including Canada. Under the convention, all ships at sea must report any hazard to navigation to the nearest CCG station. Hazards to navigation include abandoned ships, floating debris, and icebergs. Captains of seagoing vessels, including oil industry vessels, are obligated to report first sightings of icebergs to the CCG. These reports are broadcast by the CCG as observations from "Ships of Opportunity". Although user requirements focus largely on the needs of industry personnel, the reporting requirements for regulators should not be overlooked. In fact, reports to the regulators form an important requirement for the operators, as part of their license agreements for drilling.

This section will attempt to define and describe the rationale for user requirements for pack ice and iceberg information. The focus will be on the needs of shore-based and rig-based personnel from the four principal winter drilling operators in 1985: H/BV, PCI, Mobil and Esso, as a base for establishing future needs. It should be appreciated that user requirements will vary according to the operating philosophies of each company. User requirements are also a function of the personalities involved within each company and the relationships which have been developed between companies.

One aspect of this type of user requirements study which must be appreciated is that the interviewees usually base their responses on their knowledge of what products are currently available rather than on anticipated future needs. IDMS operated as an industry ice information system in 1984 and 1985, and the users of the system spent a great deal of time and effort in specifying their requirements for ice information as well as the methods of presenting this information in the form of hard copy products. (It should be noted that in the more than 40 interviews conducted there was only one mention of a specific product requirement which was not fulfilled by IDMS in 1985. This will be discussed later in this section.) Therefore, this study used the 1985 IDMS products as a point of departure for defining future requirements which may include new products designed to meet the needs associated with future drilling activities.

We will first present an overview of future east coast ice surveillance by government and industry and a concept for the design of a future ice data management system. We will then classify and describe the different types of users of ice information and their relative roles in ice management. The statement of user requirements will be defined in terms of the data products which were specified in detail by the operators and used during 1985, and an assessment of changing future needs. Next, we will describe the communication requirements of the operators in terms of rig to shore, rig to supply vessel, shore to IDMS and so on. This will be followed by statements on the requirements for forecasting and archiving of information and requirements for input data reporting and processing.

4.1.1 Overview of Future East Coast Ice Surveillance

Currently, AES conducts routine ice and iceberg surveillance off the east coast of Newfoundland and Labrador. These regions, including the Grand Banks, are overflown every second day according to AES. In addition, there is and will be regular reconnaissance by IIP, which conducts flights once per week in coordination with AES, to determine the southern limit of icebergs. Although IIP flights are often concentrated on areas south of the Grand Banks, actual flight patterns depend on the known southern limit of icebergs, which on occasion is near the offshore drilling area.

Given the regularity of AES/IIP coverage off the east coast and the overlap with industry surveillance, it is appropriate to examine the relationship between AES and industry and the roles each could play in a coordinated east coast ice and iceberg surveillance program.

The AES system is one hub in the flow of ice information. AES, in coordination with IIP, provides regional reconnaissance information and archiving of data products. The IDMS system would be the interface between industry and AES when several operators are drilling. If only one offshore operator were present, AES would be interfaced directly with that operator, since a central IDMS would not be required. The local ice and iceberg data obtained by industry in their area of interest may be forwarded to AES, and the regional data collected by AES/IIP may be retrieved by industry from AES. This model of information exchange could be used in any offshore drilling area, provided it is within the scope of AES regional ice reconnaissance.

In the future, AES will assume some of the functions performed in the past by the industry IDMS. Most notable will be the management of CCG ships of opportunity data. AES presently receives ice and iceberg reports from CCG St. John's. These reports will be checked against other reports, and duplicate sightings will be eliminated. This will result in a coded file of data accessible from AES, by IDMS or an individual operator.

Therefore, in a future IDMS, all ice data from third parties, such as CCG, will be available in quality-controlled form from AES.

From an industry point of view, the regional ice data collected by AES and IIP supplements the strategic and tactical data collected by industry.

4.1.2 Classification of The Types of Users

It is important to define who the users are to place their information requirements in perspective. There are essentially three groups of users:

- Industry operators,
- Regulatory authorities,
- Significant third party interests.

Industry operators include shore-based and rig-based personnel as identified in the Joint Ice Management Plan. Within a given operating company, individuals have specific duties and use the information products as an aid in performing their job function. Information products produced by IDMS must be directed primarily at the requirements of the industry operators.

Table 13 identifies the organizations which have been or could be involved in Grand Banks drilling operations during periods when ice and/or icebergs may be present. There will likely be other companies entering the scene in the future to conduct both exploration and production programs. The discussion in this report will deal with the needs (or lack of needs) of the organizations identified in the table, as determined in interviews with representatives of the various groups. Two of the regulatory agencies, COGLA St. John's and NPLD, were replaced by a new Canada-Newfoundland Offshore Petroleum Board (CNOPB) in early 1986. The requirements imposed on the operators by the new board may change, but for the moment the requirements of the two original agencies remain valid.

Industry operators can be divided into three distinct groups:

1. Those involved in short term exploration drilling programs, usually consisting of one or two wells;
2. Those involved in multi-year exploration drilling programs including several wells;
3. Those involved in long term production programs.

Table 13

Identification of Users and Potential Users of Grand Banks Pack Ice and Iceberg Information

1. Industry Operators
   - Husky Oil Operators Ltd.
   - Chevron Canada Resources
   - BP Resources Canada
   - Gulf Canada Resources

2. Regulatory Authorities
   - Canada/Newfoundland Offshore Petroleum Board (CNOPB)
   - Canada Oil and Gas Lands Adminstration
     - Ottawa
   - Canadian Coast Guard (SOLAS agreement)

3. Signficant Third Party Interests
   - CCG - ST. John's
   - AES Ice Branch
   - International Ice Patrol

To date, only the first two groups have been present on the Grand Banks; however, with production planned for the Hibernia and perhaps Terra Nova fields, the third group will be present at some point in the future.

The first group consists of operators who are active on the Grand Banks for short periods at a time, and who conduct relatively short programs consisting of the drilling of one or two wells over a two to four month period. Depending on the season, ice monitoring may not be required. Even if ice monitoring is required, certain members of this group have little or no interest in joint ice management, in particular IDMS, and participate based on regulatory requirements, costs, and stage of development of the plan/system. According to one operator, his company would participate in IDMS only if regulated to do so. The Grand Banks operators which may be included in this first group are Canterra Energy Limited, Gulf Canada Resources, ESSO Resources Canada, Northcor, and BP Canada.

The second group consists of operators who are committed to a multi-year program involving the drilling of several wells and requiring a continued presence over one or more ice seasons. These operators are generally more interested in cooperation among themselves and with AES. The operators included in this group are Husky/Bow Valley East Coast Project, Mobil Oil, and Petro-Canada.

The individuals involved in joint ice management, their regulators, and other interested parties can be classified into the following four types of users:

- Data Providers,
- Data Providers/Users,
- Data Users,
- Data Processors.

Table 14 classifies the individuals involved in joint ice management and IDMS, as well as regulators and third parties, into these four types. Within each operating company, specific individuals may carry differing titles when related to the table.

Data providers include those who strictly provide input information to the system and do not directly use any products for purposes related to operations. These groups, however, still impose some requirements on the system in order to make their reports more effective.

Data providers/users perform the dual role of receiving information and relaying it to other parties, as well as using it in making operational decisions. Within the organization of each operator, the rig ice observer and shore-base ice coordinator are the key individuals involved in this process. The rig ice observer in most cases receives the information from vessels, from aircraft, and from shore base, as well as performing his own

Table 14

Classification of Types of Users

Type	PERSONNEL AND GROUPS
Data Providers	Industry Vessel Captains/Watchkeeping Officers SLAR Aircarft - contracted Visual Aircarft - contracted Rig and shore radio operators (mechanism for data distribution)
Data Providers/Users	Industry Rigs - Ice Observers Shore Base - Ice Coordinators Signficant Third parties Atmospheric Environment Service Ice Branch (AES) Canadian Coast Guard (CCG) International Ice Patrol (IIP)
Data Users	Industry Rigs --Company Representative --Rig Captain --Drilling Engineer Shore - Morning Meeting Personnel - Drilling Supervisor/Engineer - Logistics Representative - Upper Management - St. John's - Management - other cities Regulators CNOPB COLGA - Ottawa CCG - SOLAS agreement
Data Processors	IDMS AES

monitoring function. He passes this information to the ice coordinator at shore base and must also provide briefings to other rig-based personnel including the rig captain, drilling engineer and the company representative on the rig. The ice coordinator in turn passes information via the shore base radio operator to the central IDMS facility which provides the information to other users, including third parties and regulatory bodies. The ice coordinator also provides information to his own management and other personnel involved in day-to-day operations and in making decisions as to when and where to deploy ice reconnaissance and management resources based on the information provided by the rig ice observer and IDMS. Some ice coordinators also have the responsibility of deploying the supply vessels for ice reconnaissance and towing duties, and of deploying the reconnaissance aircraft. Therefore the ice coordinators and ice observers have multiple roles in ice management which impose differing requirements for receiving data and using it for operational decisions.

AES and IIP operate a coordinated reconnaissance effort to monitor ice distribution in east coast waters. Ships of opportunity report ice sightings to CCG St. John's. All these data are forwarded to the AES Ice Centre in Ottawa in digital format. These data are processed by the AES and are available to users in coded and product form.

Proposed flight schedules and pre- and post-flight messages are also available to industry to assist them in planning industry-sponsored ice surveillance.

AES is also a data user and wishes to receive ice information to enhance the regional data base, to assist IIP, and to include in the national archive.

Data users are strictly involved in using the ice and iceberg information to make operational decisions or regulatory safety and operational audits. There are also a significant number of groups in management in St. John's and other cities which use ice and iceberg data for information purposes. In this context, the "nice to know" aspect is much different than the need for information to make operational decisions.

The final group are the data processors including IDMS. IDMS focusses on the regional, strategic, and tactical perspective and incorporates data collected during regional aerial coverage by a government agency such as AES as well as the information specific to each rig and each operator. IDMS receives all available ice data and attempts to present a comprehensive collated picture of the existing ice situation for a client group.

4.1.3 Data Product Requirements

LIST OF PRODUCTS

Assessment of user requirements for pack ice and iceberg information is based primarily on an analysis of the data products developed and used during the 1985 season. This analysis was based on the results of the interviews with IDMS users, who were also asked to suggest what additional information or products would have been useful. The 1985 product list was used as a point of departure for specification of future requirements, including AES products and those required to support new systems such as production platforms and shuttle tankers. Because the new systems will not likely be put into use for a few years, this report provides only an overview of what types of products may be required.

In 1985, there were a total of 36 core products comprising the daily Ice Status Report, with a further 8 products displaying only the data from industry SLAR reconnaissance. The SLAR data products were similar in format to the core data products. The products from IDMS 1985 are tabulated in the data product matrix in Appendix B. The user survey indicated that the types of information contained in the products were fully satisfactory and that no new products or ice parameters were requested, with one exception. COGLA St. John's and the NLPD expressed a desire for a printed product which would display iceberg drift speed and direction, including a listing of past reports of this information. Other than this request, the data products met the user requirement for types of information displayed. Factors relating to the timeliness and frequency of reporting and the accuracy of the information were considered the major shortcoming of the system.

Based on the experiences of 1984 and 1985, industry decided to investigate other airborne remote sensing systems as alternatives to SLAR and visual surveillance. However, an IDMS requires essentially one end product from any surveillance system, namely a digital data set containing the ice observations. In subsequent sections of this report, data and data products specific to airborne systems will be referred to as surveillance aircraft products.

Many of the users of the ice data products stated that the number of data products available was imposing, and that many were variations on the same theme. It was suggested by these users that the number of data products be decreased. However, other product users, more familiar with system capabilities and more involved in the totality of ice data managemement, suggested that a reduction in the number of products was not generally favoured; indeed, they suggested that the number of products could be increased if forecasting, archiving, and iceberg re-identification software were improved. This difference between user groups leads naturally to a differentiation of products into two groups - those who use the products as input to a specific component of ice management (e.g. support vessel a specific masters), and those who use the products as tools to support the use of all ice management resources (e.g. ice coordinators). The former group generally receives products intented for general distribution; the latter group generally specifies those products required to obtain the best picture of the overall ice situation. It should be understood that the production of a plethora of data products. Therefore, both groups described above can be accomodated in that those requiring a limited number of products will be presented a limited list, whereas those requiring a full range of products will be presented with an extended list of options. Given this fact, we will hereinafter limit the discussion of data product requirements to those required for general distribution, recognizing that an extended range of products can be made available without difficulty.

The IDMS map products (see Appendix B) were presented in five map scales in 1985:

1. Newfoundland Waters Map
2. Grand Banks Area Map
3. Drilling Area Map
4. Rig Site Map
5. Quadrant plots

Using software options, the scale of some of these maps can be expanded or contracted to duplicate other map scales (e.g. users could easily alter the scale of Map 2 to match the default scale of Map 3). Not all the users appreciated this option, and often created and distributed products at all the scales when only one or two were needed. Some of the scales are not required on a continuous basis and so need not be listed (unless clients have a desire for the convenience of such selection options), recognizing that the software can produce them when necessary. On the basis of interviews with the users, ice maps for general distribution are required on three basic scales:

1. The regional scale, covering an area somewhere in size between the Grand Banks area map and the Newfoundland Waters map.

2. The strategic scale, covering the drilling area.

3. The tactical scale, covering the area around a particular rig.

Maps at scales 1 and 2 should be in some standard map projection (e.g. transverse Mercator), while Map 3 should be a polar Plan Position Indicator (PPI) plot centered on the rig location. All scales should be variable and user-selectable, to allow the flexibility required for specific applications.

The rig PPI plot presents tactical information specific to one rig, while the drilling area map presents strategic information of interest to all operators, which is the essence of joint ice management. The regional ice map addresses the interests of third parties such as AES and IIP as well as part of the requirements of the regulators, and is also a long term planning aid for the operators.

Based on the user survey, some additional products were identified as candidates for elimination, namely, printed products listing nowcast or forecast ice positions in latitude/longitude. While it was necessary for IDMS to work with the data in latitude/longitude coordinates for manipulation purposes, for many users the final outputs were best expressed in terms of range and bearing, because this form conveyed the relationship between ice and rigs in the most succint manner. The agencies which had an interest in observed latitude/longitude positions of ice and icebergs were AES and CCG, both of whom report their information in these terms to a larger community over a wider area, and COGLA, who required that the operators report ice positions in latitude/longitude. Also, certain industry users required latitude/longitude positions for planning and briefing purposes.

According to the users, there are a number of additional products generated by IDMS-85 which should be eliminated in the interest of streamlining. Under group 4 products, which include printed system summary information, products 4-2, 4-3 and 4-4 should be considered for elimination. Product 4-2, vessel usage summary, was considered to be redundant since each of the operators had more up-to-date information than IDMS. Vessel status changed often and IDMS had a difficult time establishing exact vessel usage statistics. The IDMS system usage product 4-3 was used only at the end of a month to support the invoice for IDMS operations. Product 4-4, report data sources, was considered to be redundant and superfluous when there was a good areas searched map (Product 1-6). Although these products each had a design purpose, and the operators retain the right to have an IDMS generate any product deemed necessary or desirable, such products require software development effort and consume time during operations, so that they are prime candidates for elimination in any attempt to optimize system performance and efficiency.

With these rationalizations, the IDMS product list for general distribution is considerably reduced. Table 15 presents the list of products which will be discussed in terms of user requirements. The number of regular ice status report products listed in user menus reduces from 36 to 18, and the SLAR (now surveillance aircraft) products from 8 to 5. Examples of these data products are contained in Appendix E.

There are a number of additional products generated by AES which could be disseminated by an industry IDMS when it is in place for multiple operators. The following products are available from AES:

1. AES digital iceberg reconnaissance messages
2. IIP digital iceberg reconnaissance messages

Table 15

Reduced List of IDMS Data Products to be Considered for User Requirements

Group 1: Estimated Conditions at Report Valid Time

1-0 Ice Status Report Synopsis
1-1 Estimated Iceberg Conditions
1-2 Regional Ice Map (renamed)
1-4 Drilling Area Ice Map
1-5-0 Rig Site Ice Map - Complete
1-6 Areas Searched Map

Group 2: Forecast Status for the Next 48 Hours

2-1 Regional Ice Map - Forecast Version (renamed)
2-2 Drilling area Ice Map - Forecast Version
2-3-0 Rig Site Ice Map - Complete Forecast

Group 3: Printed Ice Information

3-1 Last Observed Iceberg Data
3-3 Forecast Iceberg Positions - Range/Bearing from Wellsite
3-4 Forecast Closest Sea Ice - Range/Bearing from Wellsite
3-5 Summary of Assigned Iceberg Numbers

Group 4: Printed System Summary Information

4-1 Vessel Status

Group 5: Last Observed Status

5-1 Last Observed Iceberg Concentraions
5-2 Regional Ice Map - Last Observed (renamed)
5-4 Drilling Area Ice Map - Last Observed
5-5-0 Rig Site Map - Last Observed

Group 6: SLAR Data Products

6-1 Iceberg Concentrations
6-2 Regional Ice Map
6-5-0 Rig Site Map - Complete
6-6 Areas Searched Map
6-7 Printed SLAR Targets
6-8 SLAR Flight Information

3. AES proposed flight schedules for 2 weeks, updated once per week
4. AES flight schedules for 3 days, updated daily
5. AES pre- and post-flight messages
6. IIP flight planning messages
7. CCG ships of opportunity iceberg sightings
8. AES most recent observations of icebergs - regional scale
9. AES nowcast of iceberg positions
10. AES observed sea ice charts
11. AES narrative bulletins describing sea ice edge and iceberg limit as latitude/longitude coordinates.

AES and IIP aerial reconnaissance observations and CCG iceberg sightings are maintained in standard AES/IIP code and are available to users 24 hours per day. All other products are available as scheduled releases after 0800 hours Ottawa time (0930 St. John's time).

All AES/IIP/CCG products could be accessed by industry operators through IDMS or individually. They would assist in providing the baseline regional information and in planning more site specific and timely surveillance aircraft flights. This study did not examine industry needs for these products in detail, but it would be advantageous for an industry IDMS to be capable of receiving and disseminating at least some of these digital products to its users.

DATA PRODUCT USE

Requirements for the data products relate to the frequency of updates, the times of day the product is needed and the relative importance of the products in making informed operational decisions. The primary requirement is that the product be as accurate as possible when issued. This requirement is best met by producing the product in a timely manner and minimizing the turnaround time of incoming information.

It is apparent that the data products are used in a number of ways:

1. To assist in deciding on the deployment of aircraft and vessels for ice reconnaissance.
2. As an aid in deciding which ice management procedures to implement.
3. To assist in making operational decisions relating to the rig and the drilling operation on a day-to-day basis.
4. For long range logistics planning.

In general, the more removed a person is from the drilling operation, the less the need to know details. These individuals also do not need to know the situation as frequently. These individuals generally include upper management in St. John's and in other cities who are generally satisfied in knowing the ice situation once per day. In critical ice situations the ice coordinator can interface directly with the rig, bypassing IDMS, and keep shore-based management completely informed.

Much of the use of the products is related to attempting to anticipate events and having the resources and the strategies in place to deal with whatever situation may arise. For regulators, the products help in developing the "what if" scenarios they need to evaluate the actions taken by the operators. The products are used by the operators in anticipating what ice might do and in optimizing the deployment of aircraft and vessels for surveillance and ice management operations. There are still judgements which must be made by appropriate individuals, but the products are there to assist (not replace) making informed decisions. The need for accurate, timely products increases for these purposes.

Another consideration for data products relates to the operating hours at the shore base and the rigs. While all rigs operate on a 24 hour basis, most of the personnel at shore base work an 8 to 10 hour day except during critical ice situations when the hours can be much longer. Only the shore base radio operators work on a regular 24 hour schedule. However, the majority of operators do not utilize shore personnel beyond a regular work day unless there are problems on the rig or when there is a critical ice situation. Many of the IDMS products are not needed on a 24 hour basis simply because there is no requirement for the ice coordinators to disseminate such products that frequently, except perhaps to the rig.

DATA PRODUCT REQUIREMENTS

The data products required by the provider/user and user groups are listed in Table 16. The list was generated from a synthesis of the results of interviews with more than 40 individuals. The product titles and numbers correspond to those used in 1985. For each IDMS product number, frequency, time of day, importance and use of the product are specified. The importance of each product for each type of user is rated on a scale from 1 to 5, with 1 corresponding to a critical requirement while 5 indicates little or no requirement. It should be noted that the types of users and their requirements have been made generic and represent the collective or majority view of the users. The tables present an integration of the requirements of individuals from all industry operators. Where major deviations from the concluded requirement have been stipulated by an operator's representative these differences are indicated in the notes following the table. Possible future data product requirements are discussed later in this section.

Third party users such as IIP and CCG will have their requirements satisfied by AES. Therefore, the third party user requirements to be met by IDMS will be coordinated by one party, namely AES, who will obtain informartion from IDMS and disseminate products to other third party agencies.

Table 16

Data Product Requirements By Type Of User

Product NO. And Title	Type Of Requirement	Provider/User			User				
		Rig (Ice Observer)	Shore (Ice Coordinator)	Third Parties (AES/CCG IIP)	Rig (Rig Captain Drilling Eng, Company Rep)	Shore			Regulators (Colgla, NLPD, CCG-SOLAS)
						Morning Meeting	Management	Other Op's (Drilling, Logistics)	
1-0 Ice Status Report Synopsis	Frequency Required	1/day	2/day	NR	1/day	1/day	1/day	1/day	1/day
	Times Of Day Required	0900	0730 1600	---	0900	0900	0900	0900	0900
	Importance (Scale 1-5)	4	2	---	4	2	3	2	3
	Use	Information Briefings	Report Preparation Planning Briefings	---	Information	Information	Information	Information Planning	Information
1-1 Estimated Iceberg Concen-tration	Frequency Required	NR	1/day	NR	NR	1/day	1/day	1/day	NR
	Times Of Day Required	---	0730	---	---	0900	0900	0900	---
	Importance (Scale 1-5)	---	2	---	---	3	3	2	---
	Use	---	.Report Preparation Long Term Planning Briefings	---	---	Information	Information	Information Long Term Planning	---
1-2 Regional Ice Map Nowcast	Frequency Required	1/day	2/day	NR	NR	1/day	1/day	1/day	1/day
	Times Of Day Required	0900	0900 1600	---	0900	0900	0900	0900	0900
	Importance (Scale 1-5)	3-Pack ice 4-icebergs	1	---	3-Pack ice 4-icebergs	2	3	2	3
	Use	Information Briefings	Report Preparation Short Term Planning Briefings Management Aircarft Surveillance	---	Update From Other Operators Information	Information	Information	Information Planning	Information Report Preparation Establish Scenarios

Table 16

Data Product Requirements By Type Of User

		Provider/User			User				
Product NO. And Title	Type Of Requirement	Rig (Ice Observer)	Shore (Ice Coordinator)	Third Parties (AES/CCG IIP)	Rig (Rig Captain Drilling Eng, Company Rep)	Shore			Regulators (Colgla, NLPD, CCG-SOLAS)
						Morning Meeting	Management	Other Op's (Drilling, Logistics)	
1-4 Drilling Area Ice Map Nowcast	Frequency Required	NR	1/day	NR	1/day	1/day	1/day	NR	1/day
	Time Of Day Required		0730	---	0800	0900	0900	---	0800
	Importance (Scale 1-5)		2	---	4	3	3	---	0800
	Use		Briefings Short Term Planning	---	Information	Information	Information	---	Information
1-5-0 Rig Site Ice Map Nowcast	Frequency Required	NR	2/day	NR	NR	1/day	1/day	1/day	1/day
	Times Of Day Required	---	0900 1600	---	---	0900	0900	0900	0800
	Importance Scale 1-5)	---	2	---	---	2	3	2	2
	Use	---	Report Preparation Briefings	---	---	Information Planning	Information	Information Planning	Information Establish Scenarios For All Rigs
1-6 Areas Searched Map	Frequency Required	1/day	2/day	1/day	1/day	1/day	1/day	1/day	1/day
	Times Of Day Required	0800	0730 1600	0900	0800	0900	0900	0900	0800
	Importance (Scale 1-5)	2	1	1-(Aes IIP) NR-CCG	2	1	2	1	1
	Use	Vessel Surveillance Planning Information	Aircarft and Vessel Surveillance Planning Briefing	Aircarft Surveillance Planning	Planning	Daily Planning	Information	Daily Planning Information	Information Daily Briefing

Table 16

Data Product Requirements By Type Of User

Product NO. And Title	Type Of Requirement	Provider/User			User				
		Rig (Ice Observer)	Shore (Ice Coordinator)	Third Parties (AES/CCG IIP)	Rig (Rig Captain Drilling Eng, Company Rep)	Shore			Regulators (Colgla, NLPD, CCG-SOLAS)
						Morning Meeting	Management	Other Op's (Drilling, Logistics)	
2-1 Regional Area Ice Map 48 Hour Forecast	Frequency Required	NR	1-2/day	NR	NR	1/day	1/day	1/day	1/day[1]
	Times Of Required		0730 1600	-	-	0900	0900	0900	0800
	Importance (Scale 1-5)	-	2	-	-	2	3	2	2
	Use	-	Briefings Short to Medium Term Planning Vessel and Aircraft Planning	-	-	Information Medium Term Planning	Information Longer Term Planning	Short to Medium Term Planning	Information Short to Medium Term Planning & Verification
2-2 Drilling Area Ice Map-48 Hour Forecast	Frequency Required	2/day[3]	2/day[4]	NR	2/day[3]	1/day[1]	1/day	1/day	1/day[1]
	Times Of Day Required	0800 1800	0730 1600	---	0800 1800	0900	0900	0900	0800
	Importance (Scale 1-5)	2	2	---	2	3	3	3	2
	Use	Short Term Planning Briefing	Short To Medium Term Planning Briefing	---	Short Term Planning	Information	Information	Information Short Term Planning	Information For All rigs
2-3-0 Rig Site Ice Map 48 Hour Forecast	Frequency Required	2/day[3]	1/day[4]	NR	2/day[3]	1/day	NR	1/day	1/day[1]
	Times Of Day Required	0800 1800	0730	-	0800 1800	0900	-	0900	0800
	Importance (Scale 1-5)	2	3	-	2	3	-	3	3
	Use	Short Term Planning Briefing	Short Term Planning Briefings	---	Short Term Planning	Information Short Term Planning	- -	Short Term Short Term Planning	Information For All Rigs

Table 16

Data Product Requirements By Type Of User

Product NO. And Title	Type Of Requirement	Provider/User			User				
		Rig (Ice Observer)	Shore (Ice Coordinator)	Third Parties (AES/CCG IIP)	Rig (Rig Captain Drilling Eng, Company Rep)	Shore: Morning Meeting	Shore: Management	Shore: Other Op's (Drilling, Logistics)	Regulators (Colgla, NLPD, CCG-SOLAS)
3-1 Last Observed-Iceberg Data (Printed Table)	Frequency Required	Always[5]	2/day[6]	1/day	Always[5]	1/day	1/day	1/day[7]	1/day
	Times Of Day Required	Always (24 hrs.)	0730 1600	0900	Always (24 hrs.)	0900	0900	0900	0800
	Importance (Scale 1-5)	1	1	2	1	1	2	2	1
	Use	Continous Monitoring Short-term Planning, vessel deployment planning	Briefing Short term Planning	Cross-Check their own data & fore-casts. Rep-orting to third parties	Short term Planning	Information Short-term Planning	Information	Information Short-term Planning	Information Briefings & Development of scenarios
3-3 48 Hour Forecast Iceberg Positions Range/ Bearing Form Rig/ Wellsite	Frequency Required	2/day[3]	1/day[4,8]	NR	NR	1/day	1/day	1/day	1/day[1]
	Times Of Day Required	0800 2000	0730	-		0900	0900	0900	0800
	Importance (Scale 1-5)	1	2	-		2	3	2	2
	Use	Short-term planning Briefing	Short-term planning Briefing	-		Information Planning	Information	Information Planning	Information Briefings For all Rigs
3-4 48 Hour Forecast Closest Sea Ice - Rnge/ Rigs/ Wellsite	Frequency Required	2/day[3]	1/day[4,8]	NR	NR[9]	1/day	1/day	1/day	1/day[1]
	Times Of Day Required	0800 2000	0730	-	-	0900	0900	0900	0800
	Importance (Scale 1-5)	1	2	-	-	2	3	2	2
	Use	Short-term Planning Briefing	Short-term Planning Briefing	-	-	Information Planning	Information	Information Planning	Information Briefings For All Rigs

Table 16

Data Product Requirements By Type Of User

Product NO. And Title	Type Of Requirement	Provider/User			User				
		Rig (Ice Observer)	Shore (Ice Coordinator)	Third Parties (AES/CCG IIP)	Rig (Rig Captain Drilling Eng, Company Rep)	Shore			Regulators (Colgla, NLPD, CCG-SOLAS)
						Morning Meeting	Management	Other Op's (Drilling, Logistics)	
3-5 Summary Of Assigned Iceberg Numbers	Frequency Required	1/day[10]	1/day[10]	NR	NR	1/day	NR	NR	NR
	Times Of Day Required	0900	0730	-	-	0900	-	-	-
	Importance (Scale 1-5)	1	1	-	-	4	-	-	-
	Use	Iceberg ID Briefings	Information Briefings	-	-	As briefed by the ice	-	-	-
4-1 Vessel Status Report	Frequency Required	2/day[11]	1/day +[12] other times as required	NR	2/day[11]	1/day	1/day	1/day	NR
	Times Of Day Required	0600/1200 1800/2400	0730 plus other times as required	---	0600/1200 1800/2400	0900	0900	0900	---
	Importance (Scale 1-5)	1		---	1	2	3	2	---
	Use	Planning	Planning Briefings	---	Planning	Planning	Information	Planning	---
5-1 Last Observed Iceberg Concen-trations	Frequency Required	NR	1/day	1/day	NR	1/day	1/day	1/day	1/day
	Times Of Day Required	---	0730	0900	---	0900	0900	0900	0800
	Importance (Scale 1-5)	---	2	2	---	3	3	2	2
	Use	---	Briefings Longer Term Planning	Augment their Own data	---	Information Planning	Information	Information Longer Term Planning	Information Briefings Devlop Scenarios

Table 16

Data Product Requirements By Type Of User

Product NO. And Title	Type Of Requirement	Provider/User			User				
		Rig (Ice Observer)	Shore (Ice Coordinator)	Third Parties (AES/CCG IIP)	Rig (Rig Captain Drilling Eng, Company Rep)	Shore			Regulators (Colgla, NLPD, CCG-SOLAS)
						Morning Meeting	Management	Other Op's (Drilling, Logistics)	
5-2 Regional Ice Map-Last Observed	Frequency Required	1/day	2/day	1/day	1/day	1/day	1/day	1/day	1/day
	Times Of Day	0900	0730	0900	0900	0900	0900	0900	0800
	Importance (Scale 1-5)	4	2	2	4	4	3	3	2
	Use	---	Briefing Planning Information	Augment their own data	Information	Information	Information	Information	Information Briefings
5-4 Drilling Area Ice Map-Last Observed	Frequency Required	1/day	2/day + updates as required	NR	2/day	1/day	1/day	1/day	1/day
	Times Of Day Required	0800 1600	0730 1600	---	0800 1600	0900	0900	0900	0800
	Importance (Scale 1-5)	2	1	---	2	2	3	3	1
	Use	---	Information Briefings	Briefings Short Term Planning	---	Information Planning	Information	Information	Information Briefings Planning
5-5-0 Rig Site Ice Map - Last Observed	Frequency Required	NR[13]	2/day +[14] other times as required	NR[1]	NR[13]	1/day	1/day	1/day +[14] other times as required	1/day[15]
	Times Of Day Required	---	0730 1600+ other times	---	---	0900	0900	0900 + other times	0800
	Importance (Scale 1-5)	---	2	---	---	3	3	2	1
	Use	---	Briefings Planning	---	---	Information	Information	Planning	Briefings Development of scenarios for each rig

NOTES ON TABLE 16

1. In general, COGLA and NLPD preferred last observed to nowcast or forecast products based on the limitations of present models. However if these models could be sufficiently improved, then nowcast would be the preferred product.

2. Forecast requirements of the ice coordinator would be increased to twice a day if the observed information deviated substantially from the morning forecast. He would like to have the option to obtain a forecast towards the end of the working day to determine if there are any major changes or situations to manage during his off hours.

3. Rigs would prefer shorter term forecasts (from 6 to 12 hours) more frequently than longer term forecasts. These are supplied by the shore base ice coordinator from IDMS if the rig requests them. IDMS forecasts are now used only as a cross check on predictions generated on the rig, however, if IDMS forecasts are improved they would be used more often with more confidence. Rigs particularly wanted the observed track and forecast track on the same product. (Again, not all IDMS users were aware of the flexibility of data products. Plots depicting forecasts of variable duration and time step were available through options, as well as simultaneous presentations of observed and forecast tracks.)

4. The ice coordinator would need the forecast once a day for his own purposes, although he would probably access and produce it twice a day to supply it to the rig if requested by rig personnel.

5. Rigs need to know iceberg positions on a continuous basis within a radius defined by their respective contingency procedures. In general, this radius is in the neighbourhood of 30 nmi but can increase to more than 50 nmi if environmental or other conditions increase the size of the alert zones. The radius also varies amongst operators and is related to the style of operation. Outside the alert zone, the required frequency of position updates decreases to approximately once per day.

6. Ice coordinators need last observed iceberg data twice per day outside the tactical zone around the rig. If the shore base supplies this information, 24 hour manning of the shore base would be required.

7. Other operations related to drilling would likely create demand at the rig for last observed conditions at other times of the day when it was necessary to have updated information.

8. Ice coordinators want to retain the option of listing a given number of icebergs closest to each rig, eg. listing the 20 closest icebergs.

9. Other parties on the rig prefer to view graphic products rather than reading printed products since the ice observer will brief them in any case.

10. The summary of iceberg numbers should be produced as a product at least once per day, and in real-time when several icebergs are located in the vicinity of the rigs, but IDMS should have the capability of responding to new observations by assigning them numbers on an "as required" basis. IDMS should serve as the coordinator for iceberg observations between operators to provide a common reference.

11. Vessel status reports should be produced on a frequency to match changes in ice observer shifts. Each person on the rig would like to have a report on all industry vessel and rig status as an input into planning. Timing of product availability depends on the shifts of the rig personnel.

12. Ice coordinators would like to know the status of all industry vessels on a real-time basis. The minimum requirement would be once per day for morning operations planning meeting purposes, but demand could be up to several times a day depending on the ice situation. The system should have that flexibility.

13. This product is not required from IDMS to support the rig directly since they will have a more up-to-date representation their own PPI plot.

14. This product is required more frequently as ice conditions become more critical.

15. This product is required by each rig.

The table includes requirements for nowcast and forecast data products. It should be noted that these requirements assume there will be an improvement in ice drift modelling. At the time of this writing, however, it is virtually a unanimous view that forecast products are unreliable and that they present information which can be misleading.

At best, the information contained within forecasts is taken with "a grain of salt". Many of the people interviewed felt that attempts to improve the models was a laudable thing to do, and that in the future models will be incorporated into day-to-day operations as their accuracy improves and the operators become more confident in the results.

There is, however, a school of thought which believes that models will never improve enough to be used in any significant way, principally because the input information on which forecasts are based is not easily obtainable, especially in bad weather situations. In their view the way to overcome forecasting inadequacies is to step up the surveillance effort to continuously monitor iceberg and pack ice movements, and react with ice management procedures as required.

Therefore, the requirement for nowcast and forecast products can be considered as a moderate priority until the forecast models improve. However, in order to verify any improvement the products must be produced and must address the requirements listed in Table 16.

The following comments relate to each product and its use.

Ice Status Report Synopsis (Product 1-0)

This product presents a printed summary of recent reconnaissance, the outlook for weather, and a notice of the closest sea ice and/or iceberg affecting each rig. The synopsis is valid at report time (0730 local time). This product was considered to be a useful quick overview of the situation at all rigs, and acted as a "bell ringer" if problems might be anticipated that day. Most operator groups required the product early in the day, since its information helped in deciding what daily decisions and actions were required.

The ice coordinator plays a key role in terms of reception and distribution of information products. This individual requires the product earlier in the day to prepare for morning briefings and to make copies for distribution. Since each operator usually has only one ice coordinator, a second update towards the end of the working day would identify any further actions on his part that would be necessary before completing his shift, or would necessitate further action during the evening or overnight, or would require that the ice coordinator be on call.

Estimated Iceberg Concentrations - Nowcast (Product 1-1)

This product presented a regional overview of estimated iceberg densities at report time. It was not required by personnel on the rig. The product was used by some ice coordinators for longer term planning, since their role was partly to anticipate what icebergs may encroach on the drilling area within three to four days. Longer term planning was a component of the morning meeting of management personnel. The product gives an idea of the magnitude of any ice problem which may be developing.

The concentrations were updated to the report valid time using forecast models in an attempt to present a snapshot of all iceberg positions at a single point in time. This fact was not always known or appreciated by all the users, and it, along with the next two "nowcast" products, caused some confusion since the pack ice and icebergs could in reality not be in the positions indicated on the products.

Regional, Drilling Area and Rig Site Ice Maps - Nowcast (Products 1-2, 1-4 and 1-5-0)

The main function of these nowcast products was to bring all ice position information to a common point in time, mainly for the purposes of the morning meeting and for information early in the working day. The nowcast version of the rig site map was not required by the rig, since they would have the most up-to-date information on board. In general, the rigs liked to receive the regional picture once a day for their planning purposes whenever the ice situation was not immediately critical. In critical situations the rig tends to focus on a smaller tactical area, concentrating on the pack ice and icebergs nearest, or projected to be nearest, to it.

The drilling area ice map displays the ice information collected by all industry operators. The scale covers the area which is of common concern to the operators and is the essence of joint ice management.

The ice coordinator requires the products early in the day to prepare for briefings and the morning meeting. Management requires a snapshot of the entire region and their respective rigs early in the day that presents the best representation of the ice situation at the time the information is received. This was achieved by reviewing hard copy products distributed personally to them or presented during ice situation briefings at the morning operations meeting.

As indicated earlier, map products should be reduced to three scales with software options to allow selection of the scale of the regional map for viewing of a particular area, and selection of the radius of the rig PPI plot. Smaller scale maps encompassing much larger areas can be produced using existing software. These map scales could be produced on a request basis for users who are less familiar with the geographic area and need land references. Regulators indicated an interest in these products only when the forecast models are sufficiently improved.

Areas Searched Map (Product 1-6)

This product was considered to be one of the most useful, particularly for shore based personnel in charge of the overall surveillance effort. This product allowed the ice coordinators to optimize aircraft and vessel resources when initiating search patterns.

Towards the end of his working day, the ice coordinator might also require updated information regarding areas searched, to direct further searches which might be made in the early evening or early morning hours.

AES indicated that they found the product useful as a check of industry data and in identifying areas which had been overflown by surveillance aircraft, for planning their own flight lines, as well as in identifying areas in which the two data sources (industry and AES) could be correlated. AES would also use the product in conjunction with the last observed iceberg information to determine areas where icebergs were absent. They would also like to receive updates to both products as soon as updated information is available.

The regulators considered this an essential product for monitoring the operators' ice surveillance activities. As well, they use this information in preparing briefings for management and the Federal Minister's office.

Regional Ice Map, Drilling Area Ice Map and Rig Site Ice Map - 48 Hour Forecast (Products 2-1, 2-2 and 2-3-0)

Although the operators placed low levels of confidence in the predictions, the availability of forecasts was a regulatory requirement. These products would have played a more important role in decision making if they had been more accurate. In 1985, the forecasts were used as a check against decisions or projections based on the experience of the ice observers and the ice coordinators.

Last Observed Iceberg Data (Product 3-1)

This product is considered essential by almost all users since it provides a summary of actual observations, including iceberg positions, sizes, shapes, the source of the observation, and the time since the iceberg was last sighted. The information on this product supports that presented on map products. It is suggested that this product be kept continously updated.

The tables also include measured or estimated dimensions of each target, where reported. This information was less useful, and should be used with care, because it can change with each observation due to the dynamics of the iceberg itself or the different perceptions of observers. Iceberg draft was not an easy parameter to measure in the field, and it was suggested by some this parameter was not essential. However, others have suggested covers that iceberg draft is a very important parmeter, since it is presently used in determining iceberg threat to wellhead equipment, in determining iceberg towing stategies and in assessing iceberg grounding potential. Also, in future iceberg draft information will have further importance determining iceberg scour potential and assessing potential threat to flow lines, prepelines and other production-related sub-sea completions.

AES would like to receive this product as an input to their regional iceberg data base and for forwarding to IIP. The product is desired on a continuous basis; only additions to the table based on new observations are required.

48 Hour Forecast of Sea Ice and Icebergs - Range/ Bearing from Rig (Products 3-3 and 3-4)

The same comments relating to the map product equivalents apply to these printed products. There was more interest in these products on the part of some of the rig personnel since they projected the movement of pack and iceberg in parameters of importance to them, namely range and bearing from the rig. This information is very useful when pack ice is approaching from hundreds of miles away. It is less useful once pack ice is located with tactical range, since it presents an overly simplistic view of the ice situation.

Summary of Assigned Iceberg Numbers (Product 3-5)

This product was considered essential by the rig ice observers and the ice coordinators, provided IDMS confirmed that the correlation of target numbers was correct. In principle, this product enabled each operator's rig to talk to another about the same iceberg target. IDMS was expected to quality control the various observations, although several problems occurred in establishing the common reference. Therefore it is essential that IDMS receive timely and accurate information in order to make the cross reference as good as possible.

Vessel Status Report (Product 4-1)

This product attempted to list the collective status of the vessel resources of industry operators. According to some users, the main problems with the product in 1985 were that it was not updated in near real time and some information was missing that should have been added. Some users suggested that the vessel status include an inventory of equipment on board each vessel and its operational status, i.e. nets, water cannon, winches, etc. This could be accomplished if the ice coordinators provided IDMS with vessel inventory information at the start of the season and when changes occurred. This information could then be added to the routine status information obtained by IDMS every 4 hours.

Last Observed Iceberg Concentrations (Product 5-1)

The group 5 map products, which depicted last observed data, were those most frequently required by the users. The main reason for this was the low confidence in forecast models and the preference for observations of positions as opposed to forecasts.

Similar comments apply to the iceberg concentrations nowcast product (1-1), except that AES, IIP, CCG and the regulators found this and the regional map product useful when received on a daily basis.

Regional Ice Map, Drilling Area Ice Map and Rig Site Ice Map - Last Observed (Products 5-2, 5-4 and 5-5-0)

The major difference in requirements from earlier products was that the rig and shore base preferred to get the rig site map on a demand basis in near real-time, as well as for information exchange at the morning operations meeting. Part of this requirement would have likely been better met using a rig-based computer system; however IDMS could summarize the ice situation at each of the rigs on a once or twice daily basis for the purpose of informing the other operators. This should have necessitated that these products be continually updated, which was not done.

SLAR Products

Because of the newness of SLAR as an ice detection tool on the east coast in 1985, the question of the usefulness of data from the SLAR aircraft was one of the more contentious issues among the operators. Each had his own views on the validity of the information.

The frequency and timeliness of information was in the hands of the operators who controlled the timing of each flight and the area covered. The SLAR products available through IDMS were produced on a flight-by-flight basis. It should also be noted that IDMS did not control the timing or flight pattern of this data source. IDMS accepted the data from the SLAR contractor and made it available to industry users. Quality control of the data was the responsibility of the SLAR contractor.

POSSIBLE FUTURE PRODUCT REQUIREMENTS

Based on the results of the user survey, it would appear that the list of data products described above would meet the needs associated with the types of drilling programs presently conducted on the Grand Banks and in other areas. However, in future years, additional needs will arise as exploration programs change and as production programs are initiated. This section will explore some of these requirements based on future oil production scenarios for Hibernia and Terra Nova.

The onset of oil production will necessitate the use of fixed or mobile production platforms and shuttle tankers. There will be a much greater reluctance to move a mobile production platform; the fixed platform must be designed so as to withstand impact by sea ice and icebergs. In both cases there will be a critical need for effective ice management and also a willingness on the part of the operators to commit substantial resources to monitor and forecast ice and iceberg movements.

An increased surveillance effort will likely generate more ice information. This will be handled by an IDMS or by the individual operator depending on how many other operators are present and whether the operator chooses to use a central facility to meet data product needs.

With shuttle tankers and floating production systems, there will be an increased need to obtain regional data. This need will be partially fulfilled by AES, but industry surveillance will be required to supplement the AES/IIP coverage and to improve timeliness.

As airborne surveillance systems and ground-based ice detection systems improve, there will likely be an increase in the frequency of ice monitoring, especially during critical ice situations. During production, shore bases may be staffed on a continuous basis by several ice coordinators, resulting in an increased demand for data products.

The use of shuttle tankers will require route planning to and from the platforms based on critical load times. During loading these vessels will need ice protection, including effective reconnaissance, timely and accurate ice information, and support by vessels capable of icebreaking and iceberg deflection.

Combined with the production program will likely be a number of exploration programs by different operators. The needs outlined in this report will likely continue throughout the production phase, albeit at different levels. An industry IDMS will be required to serve the requirements of both exploration and production, accommodating the different schedules and emphases, and supplying widely varying quantities of ice information obtained from vessels, rigs, aircraft and ground-based detection systems.

At this time it appears that the major difference in the ice information requirements of exploration versus production drilling is related to frequency and timing. A second difference may be an increased emphasis by the production operator on sea ice distribution and icebergs in the ice pack, as these will affect shuttle tanker routing.

4.1.4 Forecasting Requirements

Notwithstanding the earlier comments by users on the state-of-the-art in pack ice and iceberg drift prediction models, there remains a requirement for forecasts ranging from 6 to 48 hours duration for guidance material and planning purposes. There is also a requirement for longer term and seasonal iceberg forecasts for planning purposes, although such predictive models are still in their infancy. Generalized opinions on model performance arise from experiences with the few models used operationally to date. There are in fact many models which have never been used operationally, and the models which have been used can undoubtedly be further "tuned".

In future oil production programs, forecasts of longer duration (e.g. 96 hours) may be required for planning shuttle tanker movements. Prediction of both sea ice drift and iceberg drift will be needed to plan the best routes.

Rigs

Reliable forecasts are required for the closest icebergs for 6 to 12 hours following the time of observation. There should be a capability to update these short term forecasts upon receiving updated observed positional information and to compare the previously forecasted positions with the last observed positions.

In general, the forecast requirements relate to free drifting icebergs or pack ice which may be within one of the alert zones of the rig, and are perceived as a potential threat. When there are numerous icebergs or the pack ice is nearby, the main concern is with the ice nearest to the rig. Any iceberg or pack ice beyond this zone ceases to be of primary interest until it moves into a position close enough to be considered part of the group of targets of concern. When the ice situation is not critical, the zone of interest expands to include pack ice or icebergs which could potentially move into the alert zones within a longer time frame. In such cases, the ice observer and rig captain have more time to respond to the potentially threatening targets and can deploy supply vessels to those targets which are projected or anticipated to be a problem in the future. Beyond a boundary of approximately 50 nautical miles, short term predictions are not required.

Shore Bases

The evolving model of ice management practices for the operators is to transfer responsibility for short term operational decisions to the rig. Thus the shore bases would be interested in receiving the short term forecasts (6 to 12 hours), but they would use them mostly for information purposes.

Shore base personnel are concerned with forecasts on a time scale up to 48 hours and over a larger area of interest. Forecasts are required to anticipate potential threats of pack ice and icebergs and allow decisions on the resources to be made available to deal with the threat. The forecasts also assist in optimizing the areas to be searched in order to obtain further observations.

For areas further removed from the rigs there is no requirement to forecast individual icebergs. What is needed are forecasts of selected icebergs in a group. These are called "ensemble forecasts". These forecasts would be used by the shore base to prioritize iceberg threat and areas for further monitoring by vessels or aircraft.

Regulatory Agencies

Forecasts are a fundamental requirement of the regulatory agencies. The regulators have indicated a need for both short and medium term forecasts to help evaluate the actions of operators during significant ice events. The availability of ice information and its presentation improves with the use of more advanced surveillance technology more refined ice data presentation systems, the role and importance of forecasting may in fact change, depending largely on the progress in the development of reliable forecasting algorithms vis a vis the increased availability and use of factual ice information.

4.1.5 Archiving Requirements

It was virtually a unanimous view that all data products and forecasts should be archived. It was suggested by some among the 40 interviewers that only quality-controlled information be entered into the archive. This is not an insignificant requirement, and it would not be done in the regional sense by any one operator. This requirement naturally falls under the mandate of IDMS, which would have a regional, strategic, and tactical perspective on the pack ice and iceberg situation and already maintains such an archive as part of its architecture.

The uses of a seasonal, quality-controlled archive are multiple. It could be used by individual operators for pack ice and iceberg data for end-of-well reports or for studies of the ice and iceberg regimes. Portions of the data could also be used as a quality-controlled data base for the further development and verification of predictive models. Such an archive could also be an important contribution for the national archive at the AES Ice Climatology Division at the Ice Center in Ottawa, where all iceberg information is archived for the long term in the digital AES iceberg code.

The long term archive could also be used for climatological studies and for climatological reference. There is a need to relate present ice conditions to historical conditions for planning purposes. The present archive has not been used extensively for these purposes, but as data is added over the years, there will be an increased need to produce historical averages.

Historical ice patterns are presently produced by AES Ice Climatology Division for regional sea ice edges and ice distribution, but are not yet available for icebergs. However, as the AES data base grows with quality controlled data, it will be possible to begin study patterns of iceberg distribution in more detail.

There is also a fundamental requirement to maintain a short term active archive which can be readily accessed. This archive would be used to store incoming reports and data from industry and other organizations such as CCG and AES. This archive is essential for cross-checking and updating information, and to quality control it to ensure the accuracy of the number and distribution of icebergs, and the consistency of the numbering system.

The short term active archive is essential for piecing together observations on ice edge location. It will be necessary to time-tag incoming position data with times of scheduled ice status reports. It should be appreciated that ice edge cannot be constantly monitored over the entire length of interest, and in general a full picture of the ice edge will be obtained only from aircraft when flights are undertaken. The remainder of the data will come from spot observations from vessels which will report at various times during the day. Incoming reports will first have to be quality controlled. A new ice edge gets checked against the old location to determine the differences. If there are any, and the analyst believes them to be reasonable, the ice edge gets updated on the active archive for that portion of the length covered by the report. The old location is then placed into the long term archive.

4.1.6 Data Provider Requirements

Data providers include the input data sources for any ice information system based on the rig, at the shore bases of each operator or at IDMS. The groups involved in gathering ice information are critical to an effective reporting system. Meeting their requirements will result in better quality and more timely data for input to the rig, to shore base and to IDMS. Therefore it is considered appropriate to review their comments and suggestions obtained in the user survey interviews which included discussions relating to IDMS-85.

The principal data providers include vessel captains and watchkeeping officers, the industry-contracted surveillance aircraft (visual and SLAR in 1985) and the rig ice observer. For vessel and rig personnel, providing data is one of several duties; aircraft personnel are dedicated to the task.

Vessel Captains and Watchkeeping Officers

It was the opinion of the vessel captains interviewed that the present ice reporting system needs to be further streamlined and procedures changed to reduce the paper load imposed by the vessel ice reports. Ice reporting is sometimes complicated by other activities the vessel may be engaged in at the time. The human resources on the vessel are often stretched to the limit when undertaking an iceberg tow which may require all ship personnel. The reporting of ice information beyond the iceberg in tow is considered to be a burden in these cases.

In general, the frequency of required reports increases as the ice situation becomes more critical. More often than not these are times when the vessel is engaged in iceberg towing or other ice management procedures, leaving little time for additional reporting. One solution to the problem would be to have additional staff on board dedicated to the task of ice observing and reporting. However, these individuals would be idle much of the time.

The suggestions reported here are more focussed on the vessel ice reports and procedures for reporting which are summarized by the following points:

1. Elimination of iceberg draft dimension in reporting since it is rarely, if ever, measured. During critical ice situations or in bad weather, it cannot be measured. Good algorithms exist for estimating iceberg draft based on above water measurements. These are satisfactory for most needs.

2. Eliminate the requirement for the vessel to calculate range and bearing from the rig. Leave this up to the rig ice observer.

3. Report iceberg size information upon initial sighting, but eliminate it in further reports on the same iceberg unless the iceberg rolls or calves or the information otherwise changes.

4. A dedicated VHF channel be allocated for reporting ice information between vessels and rigs. There is often too much traffic on the present radio frequencies related to other concerns with the result that the vessels spend much time standing by trying to get their information through.

5. When there is an increase in the frequency of reporting, the information reported on a given iceberg, after the first sighting of the iceberg, should be reduced where possible.

6. Feedback from the overall ice information system on what number to call the iceberg is required. All vessels should be made aware of this number so that the iceberg can be more easily reidentified should more than one vessel encounter it.

One of the factors which affect the quality of iceberg information is the often poor observing conditions. Fog is frequently present with the result that many targets are detected by marine radar and never seen visually. This puts limits on some of the information which would normally be collected, including size and shape.

Rig Ice Observer

The ice observer has a multitude of duties to perform which include the reception of vessel ice reports and retransmission to shore base as well as observing and reporting ice conditions in the vicinity of the rig using the rig ice report. He maintains a continuous plot of iceberg positions on board and uses this, along with other information sources including IDMS products, to give briefings to rig-based personnel on an as-required basis.

Problems arise when the ice situation becomes more critical because both rig and shore base personnel are more demanding of information to support operational decisions. The observer must then balance his duties for reporting, observing and briefing.

The following requirements were identified by the observers to make their duties more manageable:

1. Reduce the paper load during times of increased reporting frequency. This would be partially fulfilled by reducing the information on the vessel ice reports as well as on their own. Once the iceberg statistics have been stated and a number assigned, the data reporting should be limited to position reports in terms of range and bearing from the rig.

2. Reduce the frequency of reports on the tactical situation to shore base or automate report generation and transmission. If the rig has the mandate to make the short term operational decisions, the ice observer's role would be to focus more on keeping rig-based personnel up to date on the ice situation as it unfolds.

Contracted Visual and SLAR Aircraft

During 1985, the two aircraft flew at vastly different altitudes and were subject to differing environmental conditions. Although the SLAR could penetrate cloud or fog to view the surface, this did not allow for visual confirmation of targets. The visual aircraft could fly under overcast conditions provided horizontal visibility was reasonable. However, the aircraft covered much less area and significant portions of the flight were conducted in patchy fog conditions, precluding data acquisition.

Positions from the visual aircraft were also suspect at times because they were based on the observer's estimate of the iceberg position relative to the flight track. Observers also have varying perceptions of distance. While there was usually little doubt the pack ice or icebergs are there, positions were subject to significant tolerance.

The SLAR position information was much more accurate, because the target positioning is tied to the aircraft navigation system through the radar ranging. Target positions are therefore reflected as latitude/longitude grid coordinates on the imagery.

Both aircraft attempted to verify the positions of ship targets at the times of their flight but this process appears to have been on a request basis over the radio. Therefore as a requirement for aircraft reconnaissance, industry vessels should be made aware of when and where aircraft will be flying and consolidate their iceberg observations and their own positions for transmission to the aircraft or to shore base for post processing. In this way the aircraft could not only identify the positions of ships but could also identify by number the iceberg targets which had been spotted by vessels. This should reduce the duplication of reports at the observing level, rather than relying solely on IDMS or the shore bases to resolve differences much later, after post flight processing. Part of the quality control problem faced by IDMS is that events overtake the situations which had been observed hours before.

4.1.7 Data Processor Requirements

To complete the statement of requirements of participants in an ice data management program, the requirements of the ice data processors must be considered. As indicated above, only the IDMS contractor has been included in this report as a processor of data for Joint Ice Management. Rig-based operations include data processing, but because the data is largely tactical in nature and not as varied as the regional data handled by IDMS, no discussion of rig-based processor requirements is presented. It is noted that such requirements have much in common with those of IDMS and generally include a forecasting capability.

The IDMS requirements listed here concern the data input to IDMS and the use of data products output by IDMS.

If IDMS is to provide timely and accurate information to users via the desired data products, it must receive the necessary data in an effective manner. Because IDMS depends on industry and other sources for the data and at present has no control over data collection and reporting, the following requirements must be addressed by industry:

1. Timely and accurate industry data (ice, vessel, and other data required on data products) must be provided by all participants in a suitable, standard format on a regularly scheduled basis.

2. Provisions must be made to facilitate communications between IDMS and data sources for purposes of data quality control.

3. Reporting procedures must facilitate the provision of reference information by IDMS, e.g. consistent iceberg numbering by data sources will aid in determining the number to be assigned for common reference.

4. Mutually beneficial relationships must be established with non-industry data sources (AES, IIP, CCG) to achieve effective information exchange.

5. Ice forecasting models of known capabilities must be selected for use and the reliability of these models made known to all users. IDMS must be provided with the environmental data and forecasts necessary to operate the models.

A recurring point in the discussion relates to the fact that, in 1985, not all users were aware of the nature and features of all data products available. This sometimes resulted in a negative appraisal of the program if the user did not obtain the required product or if the information contained on the product was misunderstood. Therefore, an important requirement for a future system is to educate all users as to what information will be available and how to interpret it. Considering the potential number and diversity of users, this may be a difficult task.

4.1.8 Communications Requirements

Discussions with all levels of communication users of IDMS showed that no major change in the topology of the communications network was deemed necessary. However it was generally agreed that changes in the architecture of the network to permit direct input to rig-based computers, with a data link replacing the current voice, telecopier, and telex links used, would constitute a major improvement. It would ease overload periods for the ice observers and rig-based radio operators, improve reliability due to reduction of the number of times the ice data input was written down by hand, and add to the flexibility of the overall system. It would also allow IDMS to evolve into a near real-time system if desired.

However, a change from what is essentially an analog system to a data network is not a trivial one. The changes in the network, both from an economic and from a data reliability and confidentiality viewpoint, were recognized by the senior communications staff of each operator (there appeared to be little awareness at other management levels).

There should be standardized coding and computer-to-computer transfer of ice and iceberg data as much as possible, to allow exchange of information between industry operators, IDMS, and AES.
In general terms, the network that all users appear to favour is one where ice observation data obtained by support ships and helicopters would be radioed to the company's ice control rig using a VHF, UHF or HF voice channel in the same way as this portion of the communications link is handled today. It should be noted that there is, on the parts of some operators, the thought that in the future it might be possible for direct data input to take place from support ships and helicopters. This will be dealt with in detail below under the relevant section.

All rigs and ships would input ice data directly into the rig-based computer, proof and correct it on screen and communicate it via a suitable data link to the shore bases where it can be either communicated without change via the current land lines and modems to IDMS, used internally, or edited and then passed on.

Thus the major communications architecture change required by the users is the provision of an effective, reliable, and economic data link between rig-based computers and shore-based computers.

There are three main alternatives which can be considered for two-way data links between rig and shore bases. These are:

- the use of Inmarsat's Marisat data link,
- the use of HF radio data links as currently being developed by Harris, Polestar Communications and others,
- the use of single-channel-per-carrier (SCPC) data links over Telesat Canada's Anik C2 service.

Each of these has various advantages and disadvantages, which will be dealt with below. However, it is noted here that data links require either a common protocol (data message format) or comparatively expensive interfaces for converting to a common protocol. Currently, different types of rig computers are being used by each operator, thus reducing the likelihood that a common protocol for IDMS is feasible.

User requirements for the communications network will be dealt with in more detail under three main headings reflecting the three topological sections of the network, namely:

- land lines,
- rig-to-shore data links,
- ship and aircraft links to rig and shore.

Land Lines

All users were unanimous in their comments that current land lines and related modems were efficient, reliable and effective. As the data capacity of these land lines and modems (9600 baud) is considered to be suitable for direct transparent connection between a shore-to-shore IDMS data communications link, no change in the land lines is necessary.

Rig-to-Shore Data Links

The requirement for a two-way rig-to-shore data link stems from the user need for an efficient method for transmitting and receiving ice information. Currently a manual process involving voice, telecopier and telex processes is in use. It involves much manual form filling, and increases the duplication of information received from ships and rig ice observers pertaining to the same iceberg. Ice observer and radio operator loads can be significantly reduced if information is entered directly into a computer, edited, proofed and then transmitted over a data link for shore station, IDMS or possibly also third party use. Several users are currently putting data into various types of rig-based personal computers (PC's) for manipulation and storage. From a superficial viewpoint, it would appear that all that is required is that a modem be connected to the computer and the information transmitted over a radio or satellite link to shore where it can be used, processed or archived. In practice, the problem is considerably more complicated. Data links require detailed design of both architecture (how the network is connected) and protocols to meet user needs in a reliable, efficient and cost-effective manner.

For example, if all information is to be passed to IDMS, a common protocol makes a great deal of sense. Given this, there are the alternatives of individual data links from rig to shore for each user, or a shared data link. Depending upon the type of link (HF, Inmarsat or Telesat), a shared link could result in significant transmission cost savings. Should a decision be made to share a transmission link, a number of alternatives are available and further decisions will be necessary.

Basically, the choice is either HF or satellite. HF is cheaper, but much less reliable and has a low throughput. Satellite can be highly reliable and, given a full-time usage tarrif such as is available from Telesat for partial RF channels, has a potential for being cost-effective and reliable. If such an approach were taken, this opens the possibility of channel sharing between all users for not only IDMS information but all types of data traffic. It is appreciated that much of this data would be confidential, and thus this type of approach would require encryption and decryption equipment and a well-designed architecture to deal with data addressed to different users.

Data link protocols include extra bits for addressing, identification of information, error detection and error correction and various other housekeeping functions. Depending upon both the use of the data, the complexity of the network, particularly when this is a multi-user network, and the transmission medium, these "housekeeping bits", more commonly called "overhead", can become a significant portion of the message and hence reduce throughput of the information being transmitted. It will be appreciated, for example, that data transmitted over an HF link will require significant error detection, correction and message repeat overheads in its protocol to ensure reliable reception. Thus the throughput of a 2400 baud single user HF data link may be as low as 800 baud. In a multi-user situation, depending on whether or not users are polled or a contention protocol is used, overheads become considerably greater.

It is obvious from the foregoing that a data link requires considerable system engineering in each individual case to optimize reliability, capacity and cost. Such an exercise is required to meet the communications needs of IDMS and will be addressed in general terms in the final report containing the functional specifications. It should be noted, however, that an effective data link for an individual operator concerned primarily with minimizing capital costs can be implemented using an RS232C interface modem and a standard Marisat voice channel at the usual Inmarsat "permanent" rates. The operational costs of such a link will be significant if use is high. Greater throughput for the same "permanent charge" can be obtained by using more expensive modems such as the Gandalf Model 419 high speed modem capable of a 9600 baud data rate.

Ship-to-Rig and Aircraft-to-Rig Links

At present, standard VHF and UHF voice channels are used to transmit IDMS inputs from vessels and aircraft to the rigs. Most users have indicated that this meets their requirements and causes no significant delay or problem. Occasionally an aircraft cannot transmit due to a vital operation such as the landing of a helicopter occupying the VHF channel virtually full time, but the delay is usually comparatively short and has been stated to be acceptable.

It is technically feasible for UHF and VHF data links to be used betweeen ship or aircraft and a rig, and, given a well-designed integrated system, could have significant advantages by permitting inputs to the rig computer without occupying valuable ice observer time. Such data inputs could be proofed and edited by ice observers or rig radio operators before transmission to shore. It should be emphasized however than an integrated system approach would be required to ensure the protocols used on the vessel/aircraft-to-rig link were the same as, or compatible with, the overall data protocols. In addition, the ergonomics of requiring data input by air crew or supply ship crew should be thoroughly investigated before implementation of such a system.

Summary

Users have indicated that the prime communications requirement is a cost-effective, error-free data link that would transmit IDMS inputs, and possibly other data, directly from a rig-based computer. This would reduce ice observer and radio operator loading while concurrently improving IDMS input data quality. It would also permit the elimination of repetitive portions of the input by editing at the computer before transmission, reducing the paper load considerably, and facilitate the elimination of labourious manual data entry at the IDMS centre.

There are currently three main alternatives for such data links:

- HF data links, which are expensive and have a limited throughput;

- Inmarsat voice channel data links. These are highly reliable and error free and require minimal capital investment for modems and other equipment. Data speeds are typically 2400 baud but can be improved up to 9600 baud with more complex, and expensive, terminal equipment. Operational charges are high.

- A satellite data link via a single channel per carrier (SCPC) full-time channel on Telesat's Anik C2 satellite. Currently the subject of a feasibility study using stabilized antennas, this approach has the potential of an extremely cost-effective, reliable, multi-use satellite link. It is distance insensitive and can link Grand Banks to any city as far west as Thunder Bay.

It should be emphasized that any data link, to be efficient, must be the subject of a complete system analysis and system engineering exercise to avoid costly interface and reliability problems.

4.2 Analysis Of User Requirements

4.2.1 Integration of User Requirements

It is quite apparent from Table 16 that there are a considerable number of data products required at varying times of the day in various locations. The data products produced by IDMS-85 appear to satisfy almost all information requirements in terms of content, format and presentation. What remains to be improved are their accuracy as well as their frequency and timing to suit the collective need.

For the purpose of presenting the integrated product requirements, users have been reclassified into the original three groups;

- industry operators
- regulators
- third parties

The needs of the industry operators must be met first, but those of the regulators and third parties are also important. The needs of the regulators become the needs of the operators since providing the information specified in the drilling guidelines is part of their licensing agreements. IDMS-85 was particularly effective in meeting regulator needs. Direct requests to the operators were generally infrequent because the information routinely supplied was adequate, except perhaps during significant ice events when additional data was requested. Providing products to third parties such as AES, IIP and CCG generates goodwill and cooperation. AES in turn can distribute such products to agencies including IIP and CCG. In return, industry and/or IDMS could receive the regional AES ice and iceberg data.

Industry Data Product Requirements

Industry needs can be divided into products required during "good" ice situations and those needed for "bad" or critical ice situations. In a "good" ice situation there is no ice immediately threatening the rig, and more emphasis is placed on anticipating what ice situations may develop. The principal information comes from aircraft and to some extent from vessel surveillance as well as from forecast models. The focus is on the regional and strategic zones which are largely the responsibility of the shore-based ice coordinators. The emphasis is on the longer term over larger areas. Forecasts up to 48 hours become a higher priority because the ice coordinator needs to anticipate what future ice situations may develop which might require him to commit more resources, such as aircraft and supply vessels, for increased surveillance and ice management. The information allows him to advise drilling operations personnel of the anticipated ice situation to assist them in operational planning.

Critical ice situations arise whenever ice is near to or in the so-called safety zone (a zone within the tactical zone) or is forecast to be so in the near future. Here the ice management emphasis shifts to the rig and the immediate area around it. A smaller area is monitored constantly and the required forecasts are short term (6-12 hours maximum) because of the frequency of monitoring. Real-time ice information is required. This is gathered using the rig radar, from supply vessels, and from data exchange between different operators' rigs. In this situation, there is little IDMS can contribute since the responsibility and principal activity shifts to the rig from shore. IDMS must be able to accept and process data as it becomes available to update its own products, which serve as backup to any rig-specific products and source of formalized products for the operator shore bases. For IDMS to be able to produce timely and accurate products requires that the input data be made available from the rigs as quickly as possible.

Putting aside data product requirements for the critical ice situation case, the general product needs as specified in Table 16 for industry can be divided into two classes:

1. Scheduled products
2. Supplementary products (near real-time updates)

Scheduled products are produced at fixed times of the day to meet a specific daily requirement regardless of the prevailing ice situation. Supplementary products are produced in near real-time and result from continually processing incoming pack ice and iceberg information. These updated products are required on a demand basis which could be up to several times a day at irregular intervals. Generally speaking the supplementary products would be accessed by the ice coordinator or his assistant.

Table 17 lists the products required at scheduled times of the day by the rig and shore base as well as the continuously updated supplementary products which would require IDMS to operate as a real-time system. In general the rig requirements are fairly modest since most of the information will be obtained by the rig from the supply vessels. IDMS acts as a coordinator for the numbering of icebergs so this product is needed relatively frequently. The higher frequency of vessel status reports ties into the change of shifts of the rig ice observers. When shifts change every 12 hours either at 0600 or 1200 local times, the ice observer beginning the shift requires an update on the ice situation (which he obtains from the retiring observer) and on the status of available supply vessels.

The ice coordinator at shore base requires products upon starting work to plan the day (ie. the types of decisions which have to be made, the consultation which will be required) and to help prepare briefing material for the morning operations meeting. This meeting brings together all the departments involved in drilling operations. When ice is present, the ice coordinator is one of the key individuals in this meeting since information on present and forecast ice, weather, and sea state conditions is required to make

<u>Table 17</u>

Integrated Industry Scheduled and Supplementary Product Requirements

(Local St. John's Time)

Sceduled							
0000	0600	0730	0900	1200	1600	1800	0730 - 1800
<u>RIGS</u> Vessel Status (4-1) Iceberg Numbers (3-5)	<u>RIGS</u> Vessel Status (4-1) Iceberg Numbers (3-5)	<u>SHORE BASES</u> Nowcast (0730 (1-2, 1-4, 1-5-0) Forecast (Up to 48 Hours) (2-1, 2-2, 2-3-0, 3-3, 3-4) Last Observed Maps and Tables (latest one) (3-1, 5-2, 5-4, 5-5-0) Vessel Status (4-1) Areas Searched (1-6) Iceberg Concentrations (5-1) Ice Status Report (Synopsis (1-0)) Iceberg Nos. (3-5)	<u>RIGS</u> Vessel Status (4-1) Last Observed Maps & Printed Products (5-4, 5-5-0, 3-1) Iceberg Numbers (3-5) Forecasts (2-2, 2-3-0, 3-3, 3-4) <u>SHORE BASES</u> Nowcast (0900) (1-2, 1-4, 1-5-0)	<u>RIGS</u> Vessel Status (4-1) <u>SHORE BASES</u> (Calgary) Nowcast (1-2, 1-4, 5-5-0) Last Observed (3-1, 5-2, 5-4, 5-5-0)	<u>RIGS</u> Vessel Status (4-1) Iceberg Numbers (3-5) <u>SHORE BASES</u> Areas Searched (1-6) Last Observed Maps and Tables (3-1, 5-2, 5-4, 5-5-0) Forecasts (2-1, 2-2, 2-3-0, 3-3, 3-4)	<u>RIGS</u> Vessel Status (4-1) Iceberg Numbers (3-5)	<u>SHORE BASES</u> Last Observed Maps and Printed Products (3-1, 5-2, 5-4, 5-5-0) Visual/Radar[1] Aircraft Data (SLAR data products) Vessel Status (4-1) Forecasts (Up to 12 hours) Iceberg Numbers (3-5)

informed, effective, operational decisions. The IDMS products are critical for the ice coordinator to gain an understanding of the prevailing situation and its possible implications.

By 0900 hours in St. John's, the rig requires its daily package of products which are reviewed by the ice observer who in turn briefs other rig personnel on the contents, should the time be available. The shore-based ice coordinator requires a nowcast product for 0900 hours so that he can suggest where the icebergs and pack ice might be at the exact time of the morning meeting.

By 1100 hours in St. John's, management in Calgary is arriving at work and they too prefer to receive products early in the day. Meanwhile, ice observers are preparing to change shifts on most of the rigs.

By 1600 hours in St. John's, the shore-based ice coordinator is nearing the end of his working day. A subset of the products produced at 0730 is required, primarily to determine if there might be a problem overnight, and to brief operations staff before they leave the office for the day. If so, the ice coordinator can elect to extend his shift to cover off the possible difficulty, or can leave instructions with the rig ice observer on what search procedures are required for the tactical zone. If the situation is not critical, he can leave at the end of the regular working day. Thus, an earlier update time than the 1930 report time used in IDMS-85 is preferred.

The supplementary update products comprise a shorter list than the formal reports at 0730 and 1600 hours local. In updated products, IDMS must be able to change all data products quickly to reflect new or updated information on pack ice or icebergs. The updated products could be accessed at any time of the day by the ice coordinator, but would generally span regular working hours. However, IDMS would be able to provide updated products beyond this time period when necessary and when requested, if it were a real-time system with more automated data entry.

Regulator Data Product Requirements

Table 18 lists the time of day and product types which are required of industry according to the COGLA guidelines existing in 1985. In addition, regulators would like to receive forecast data products, although industry is not obliged to provide them under the guidelines. Because of the state-of-the-art in ice forecasting, the forecast data products are viewed with less confidence that observed data products. Finally, the regulators stated that they would make use of one product which was not available from IDMS in 1985, namely a table of iceberg drift speeds and compilations of speed histories for selected icebergs.

Table 18

Regulator Scheduled Product Requirements

FREQUENCY: 1/day - updates would be directly requested from the respective operators when significant events dictate

TIME REQUIRED: 0800 - 0900

PRODUCTS REQUIRED: Areas Searched (1-6)
Last Observed Maps and Printed Tables - latest version (3-1, 5-4, 5-5-0)

Third Party Data Product Requirements

In the concept of an integrated ice data management system, AES will be the interface for the so-called third parties. Industry would supply data only to AES, who would be the distributor.

AES would like to receive products on a fixed schedule as listed in Table 19. AES operates seven days per week and so would like to receive products on all days. AES would service the needs of IIP and CCG by forwarding them digitally coded data.

AES would also like to receive updates to the scheduled products, including new iceberg data complete with IDMS numbers, and aircraft reconnaissance data complete with area of coverage.

4.2.2 Daily IDMS Product Output Scenario

The product requirements presented in Tables 17, 18, and 19 allow for an examination of the total production scenario for a working day. Figure 15 constructs a daily schedule of product requirements from IDMS versus the daily time lines of the various groups involved. It is evident that the peak loading on IDMS output is from 0730 - 1800 hours local and on either side of these hours, the demand drops drastically. As indicated above, there is still a requirement for IDMS to extend its operation in terms of supplementary update products beyond those hours when ice situations demand.

In general, supplementary update products and other products required beyond the regular working day will be concentrated on recently observed data. Much less emphasis will be placed on forecasts, since the circumstances which create the need, ie. critical ice situations, necessitate more continuous monitoring and more frequent updating as new information becomes available.

In order to fulfill these requirements IDMS will almost certainly need to become a real-time system with more automated data entry.

Table 19

AES Scheduled Product Requirements

Frequency:	1/day
Time Required:	0900 Local
Products Required:	Areas Searched (1-6) Regional Ice Map - Last Observed (5-2) Last Observed Iceberg Data (3-1) (only targets observed since last report)

Additionally, AES desires updates of these products as information becomes available.

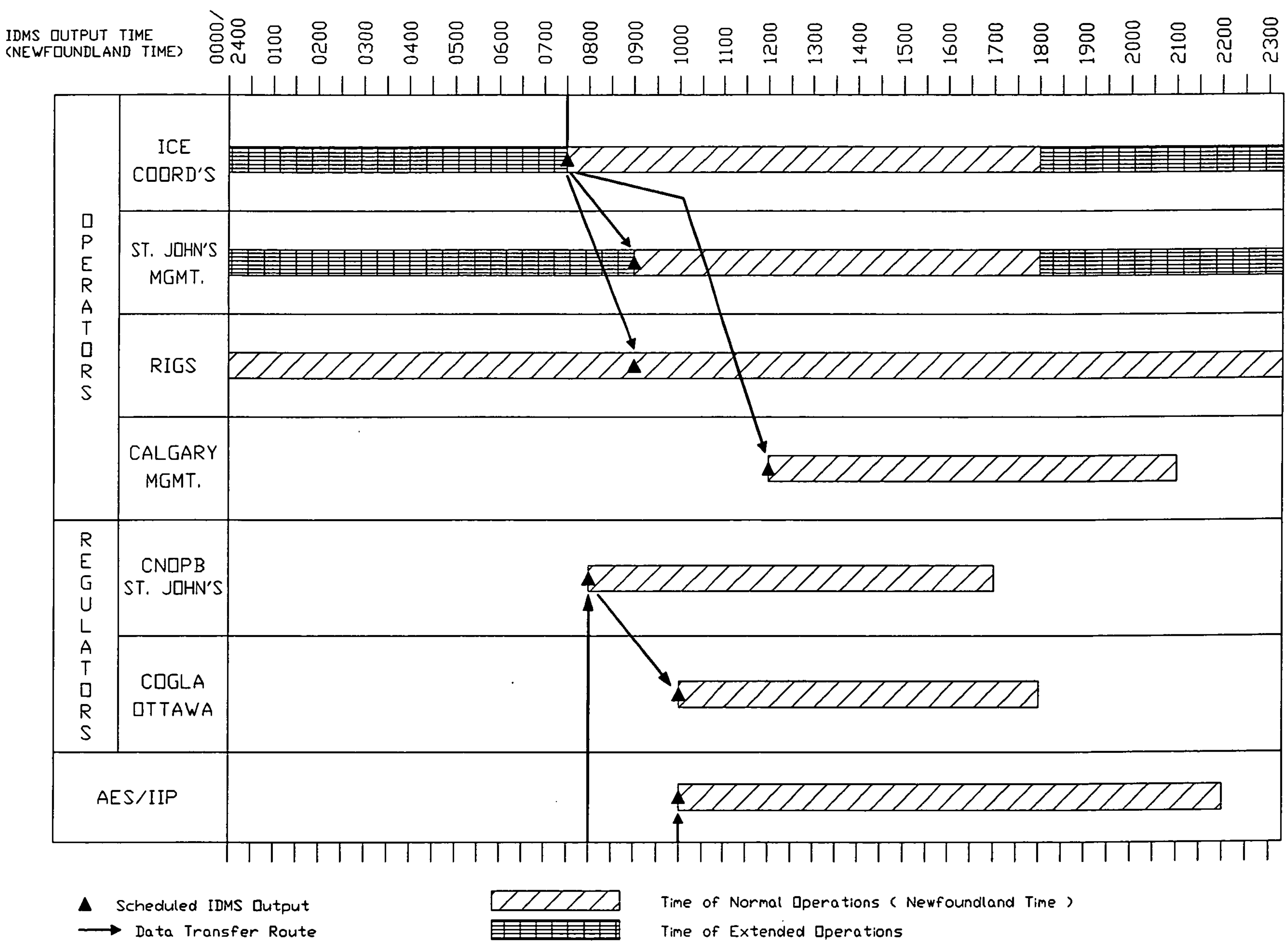


Figure 15. Schedule of Data Product Requirements as Stated by User Groups

4.3 Conclusions And Recommendations

4.3.1 System Requirements

It is clear that the data products from IDMS-85, with minor changes to accommodate a new method of surveillance such as search radar or to fine tune or streamline data handling, would meet the needs of industry, regulators, and third parties for information content, format and presentation. What remains to be improved are their timeliness and accuracy. Data product needs can be divided into scheduled and supplementary update products. All three user groups have requirements for scheduled products produced at fixed times of the day similar to the ice status reports produced by IDMS-85. The main difference is the time of day of the second report for industry ice coordinators. The second scheduled report should be moved up to 1600 hours from 1930 local time to better match the regular working day of the ice coordinator and operations staff. There is also a requirement for supplementary update products which can be accessed at any time of the day and which contain the most up-to-date information reported to IDMS. Several broad recommendations on IDMS architecture and method of operation arise from these conclusions:

1. IDMS must be a near real-time system which can automatically receive, input and update selected ice information products.

2. IDMS must include the software and systems for completely automated data input from all sources.

3. IDMS must produce scheduled and supplementary update products. The list of update products is a subset of the list of scheduled products.

4. IDMS should include computer-assisted procedures, e.g. overlap graphics to perform quality control on incoming reports, and algorithms to help in reidentification of previously sighted targets.

5. IDMS should have better communications with offshore operations.

It is evident that the zones of interest from the rig perspective are the safety (collision avoidance) and tactical zones. These should be surveyed by supply vessels supplemented with aircraft observations where necessary. The extent and frequency of this surveillance is dependent on the prevailing ice, weather and sea state conditions, the activities on the rig, the type of rig, the style of the operator, and the number of rigs and operators. When there are two or more operators with multiple rigs in close proximity, the combined area of interest is larger and the concept of a joint ice management system becomes essential. IDMS is one of the key components of joint ice management as it allows the operators to access each other's information and jointly pass on required information to regulators and other users. It fulfills the necessary independent role to quality control conflicting reports from different operators.

One of the requirements of IDMS is for forecast products. Although this class of products was used for guidance purposes only in 1985, most users wanted such forecasts. Therefore, it is recommended that:

6. Continued work be done to improve short term (6-12 hours) and medium term (up to 48 hours) forecasts.

7. Continued forecast validation methods be implemented in IDMS operation during future seasons to verify the expected improvements.

8. Forecasting of icebergs should be done on a selected basis rather than for the entire population. In the strategic and regional zones, ensemble forecasts should be attempted.

Reducing the forecast requirement will save time and expense. It does not make sense to forecast an iceberg 100 nautical miles away from a rig when there are several within 30 nautical miles unless the single iceberg is moving at some remarkable speed.

IDMS is a multi-operator, multi-rig service for joint ice management. It is a principal medium for operators to exchange ice information and it serves as the joint industry interface to regulators and third parties. The importance of these functions should not be minimized.

It is clear that AES will provide baseline regional coverage of the Grand Banks and other areas regardless of the number of active offshore drilling operators. The AES coverage will be supplemented by industry as operators gather more site specific data to meet particular needs. The ice information collected independently by each goup is of benefit to the other. Data exchange would be facilitated if the groups used compatible codes and computer-to-computer data communications. Operators could deal with AES directly, or jointly through an IDMS. It is recommended that:

9. AES and industry conduct negotiations on the exchange of ice informa -tion on a year-to-year basis. All operators planning to drill in the Grand Banks area during the ice season should participate.

4.3.2 Communications Requirements

Although the current communications network for IDMS is effective and reliable, at times of high activity the use of Inmarsat's voice and telecopier communications link becomes uneconomic. In addition, any modification of the IDMS or individual operators' ice data management system toward the use of direct inputs from rig-based computers will require a well-designed and efficient data link between the rig and IDMS and/or the shore bases.

It is recommended therefore, that should a significant change toward direct computerized input to IDMS be contemplated, that a suitable data link be designed and implemented. It is concluded that there are currently three main technical alternatives for such a digital data link, an HF link, an Inmarsat voice channel based data link and a Telesat Anik C2 satellite data link. The latter two alternatives are quite capable of fully meeting the needs of the operators.

The Inmarsat voice channel based data link is readily available, uses satellite installations currently on- board all rigs, but is expensive for prolonged use and is not readily adaptable for multi-user operation.

The Telesat Anik C2 link has the potential for being a distance insensitive, cost-effective, reliable, multi-user link capable of providing direct information to cities such as Halifax, Montreal, Ottawa and Toronto as well as St. John's. It also has the capability of being used by rigs and shore bases outside of the Grand Banks operation in such areas as Sable Island, Belle Isle, Ungava Bay, and similar Eastern Canada exploration sites and future production fields. Being a fixed cost 24 hour system it also has the capability of cost-effective multi-user use for transmission of data other than ice data. For such an operation it is recognized that high security would be required, and equipment is available to encrypt messages to military levels of security at comparatively low cost. However, the development of Anik C stabilized platforms suitable for use on rigs and possibly supply ships is in its final stages but not yet complete.

5.0 DEVELOPMENTS SINCE 1985

Since 1985, there have been a number of developments which have had a significant impact on the nature of ice data management in support of offshore operations on the Grand Banks.

Since the winter of 1986 there has been a significantly lower level of drilling activity on the Grand Banks. Husky Oil has been the only operator continuously present on the scene, while PCI has been active on an intermittent basis. Other operators, including Mobil, Chevron and Texaco, engaged PCI and/or Husky Oil to complete short drilling programs on their behalf. In the winter of 1986, both Husky Oil and PCI were active, with three rigs operating. In 1987, only Husky Oil was active, with one rig. In 1988, both Husky Oil and PCI were active, with two rigs. As of April, 1989, only Husky Oil was active. At present, no operators are drilling on the Grand Banks.

Given the low level of activity, the use of a central facility such as IDMS-85 was discontinued. Instead, the operators established a decentralized system consisting of microcomputers at each shore base. While the spirit of joint ice management was maintained, the approach to joint ice data management was not formalized, i.e. no specification regarding computer-to-computer communications and the like was established. Also, whereas in 1985 IDMS fulfilled the operators' obligations to regulators regarding data products, from 1986 to the present each operator provided regulators with their in-house products.

Husky Oil was the leader in the development of shore base systems. In the fall of 1985, Husky Oil engaged their environmental monitoring services contractor, Fenco Newfoundland Limited (Fenco), to develop a system for use in the shore base. The system hardware included a Digital Equipment Corporation (DEC) Microvax, an Apple Macintosh, and appropriate peripherals. In large measure, the system was designed to build upon the achievements of IDMS-85, introducing improvements to address some of the points raised in Sections 3 and 4. Some improvements have been made to data communications - rig to shore, shore to AES, etc. - and to iceberg re-identification algorithms. During the ice season, the operation of the system at the Husky Oil shore base closely resembled the operation of IDMS-85: the "ice room" was staffed on a regular basis by Fenco personnel who performed duties similar to those performed by Dobrocky Seatech personnel in 1985. The Husky Oil system has been operational each year since 1986.

PCI took a somewhat different approach to shore-based ice data management. In 1986, a system previously developed for use on PCI rigs, the McElhanney Ice Management System (MIMS), was installed at the PCI shore base, and an identical system was installed on the rig. The intent was to implement a computer-to-computer communications link via Inmarsat and transfer all data from the rig to the shore base, where data products would be produced by in-house personnel. For a number of reasons, this system was inadequate, and when PCI returned to operate on the Grand Banks in late 1987, they engaged their environmental monitoring services contractor, Compusult Limited, to develop a new system for use at their shore base. The Compusult system was based on an IBM PC/AT compatible computer with appropriate peripherals. Unlike the operation at Husky Oil, the PCI operation did not include regular staffing of the ice room; rather, Compusult personnel were on call to deal with ice situations as they arose.

The design of the systems described above has been greatly influenced by the following developments:

1. Industry chose to advance from a two aircarft aerial ice surveillance system (using seperate SLAR and visual surveillance aircarft) to a single aircarft combining both systems by utilizing a Litton (V) 5 search radar and onboard ice observers, to perform visual confirmation of targets. Industry, working in close cooperation with their ice surveillance contractor, developed suitable date formats and data communication systems to enable the transfer of ice data in digital form to the shore-based computer of the operator(s) sponsoring each flight. This transfer of data occurs within minutes of the surveillance aircarft landing in St. John's. The ice data management computer systems used by Husky Oil and PCI have the capability to receive data collected by the surveillance aircarft and to produce data products based on such data. In making this change, industry has also moved from the laborious task of manual input of two airborne surveillance data sets to digital input of one data set.

2. AES has implemented new systems at its Ice Centre in Ottawa and at its regional centre in Gander whereby ice data can be digitally transferred to users. At present, the transfer of data to and from industry is via the Envoy electronic mail network. Data is placed in a "mailbox" at source and retrieved by users. The systems used by Husky Oil and PCI have the capability to store, retrieve and plot the AES data.

3. Newfoundland Telephone now offers a service whereby rig-to-shore communications are via the Anik C2 satellite. PCI used the service in 1988 for both voice and data communications. The service, costing approximately $19,000 per month independent of usage in 1988, is less expensive than Inmarsat when ice data communications are at a peak. It was planned to implement a communications link based on an Anik C2 channel between the rig and shore base ice data management computers in 1988 but the link was not established. Should PCI return to drilling on the Grand Banks, it is likely that such a link will be set up.

In light of these developments, we summarize the findings of the first two tasks of the study and examine how they have been addressed:

1. *Data reporting by industry sources should be streamlined to overcome problems associated with timeliness, quality, and the workload of data providers. Specifically, firm reporting schedules and procedures should be established for offshore sources and the standard reporting forms used offshore should be redesigned to remove entries which are difficult to obtain or are infrequently used.*

   In large measure, the reporting of data by industry sources has been streamlined and standardized, and this recommendation has been adequately addressed.

2. *The communications system presently used in ice data management in 1985 was generally adequate. However, during periods of high data volume, ice observers spent considerable amounts of time merely receiving and transmitting ice data as opposed to analyzing data. Also, the use of Inmarsat links became uneconomic during such periods. Since 1985, supply vessels have begun to report ice information by voice (HF radio) to rigs and shore bases sumultaneously, thereby considerably reducing the "receive and retransmit" role of rig-based ice observers, and allowing more time for data analysis. (A multi-purpose, common satellite data system, incorporating rig-to-shore computer links, would be an effective system to fulfill all the data transmission requirements of industry. Also, the use of an HF data link should be investigated since it would offer added utility in that supply vessels or tankers would be readily incorporated into the automated data transmission system.)*

3. *The central data management facility should be operated on a 24 hour per day basis and be capable of automatic data capture. Continuous operations are necessary to meet the data product requirements of industry. Automatic data capture and updating of data products requires that effective data links with data sources must be established.*

   The Husky Oil system, developed since 1985, has addressed this. However, not all operators agree to 24-hour operation of the ice data management facility.

4. *The central facility must have an effective means of communicating with industry data sources to enable proper quality control of data. While this can be easily done if the shore-based personnel are in close proximity tothe radio room, it requires a seperate HF radio communications system if a central facility such as IDMS-85 is used.*

5. *Manual data management tasks at the central facility should be minimized through the use of appropriate computer software and human/machine interaction to maximize the time available for data quality control.*

6. *The procedures for data management at the central facility, including which data to incorporate and at what level of confidence, when to remove an iceberg or target reference from the database, etc., should be firmly established pre-season to avoid confusion.*

   Since 1986, no use has been made of a central facility. Insofar as points 5 and 6 mentioned above apply to any shore-based ice data management facility, they have been by-and-large implemented.

7. *Continued work should be undertaken to improve ice forecasting capabilities at the central facility and on the rigs. Various forecasting systems should be implemented and tested during operations. Forecasting of icebergs should be performed on a selective basis to reduce unnecessary computing. Users of forecast data products should be made aware, in qualitative and quantitative terms, of the limitations of the forecasting system.*

   Some work, sponsored by the ESRF and other organizations, has been undertaken to improve forecasting capabilities. However, industry has not yet indicated that there exist ice drift forecasting models which meet their requirements.

8. *The number, contents, presentation, and means of distribution of data products in IDMS 1985 was generally regarded as adequate by users of the system. However, in future it is necessary for the central facility to produce only a subset of the 1985 products, although the future system must provide updates to products on a continuous basis. Users should be better educated as to the availability, flexibility, and interpretation of data products. The possibilities for, and effort required to introduce new data products should be made known by the creators of the system.*

9. *The basic design of the 1985 ice data management system was seen to be sound, although the system was viewed as requiring considerable improvement in order to meet the needs of users. Various components of the system were seen to be inadequate, including data reporting, communications, operation of the central facility, and ice forecasting. Suggested improvements to the system related to its ability:*

a) to address the different requirements associated with year-to-year changes in ice conditions;

b) to accommodate the varied approaches of individual operators to ice data management (e.g. Some operators are averse to the use of rig-based computers in ice data management, while others embrace the concept);

c) to be responsive to the different requirements associated with a number of drilling scenarios for the Grand Banks region (e.g. If only a single operator is drilling on the Grand Banks a central data management facility may seem unnecessary, whereas if there are several operators active in relatively close proximity in the region, a central facility is justified).

In essence, events experienced since 1985 have precluded a joint effort on the part of industry to support the development of an ice data management system which addresses the requirements stated above. This can be attributed to a reduction in drilling operations from 6 rigs in winter 1985 to only 1 in winter 1989. This lack of support, however, does not affect the requirements for effective "joint ice management".

6.0 FUTURE ICE DATA MANAGEMENT SYSTEMS

The original scope of work for this study called for a third task of developing a functional specification for ice data management systems for the future. In view of the experience of 1986-89, it is evident to the authors, some of whom have been involved in ice management since 1980, that it would be difficult, if not impossible, to develop a detailed specification for an ice data management system which would meet all industry requirements, unless a concerted effort was undertaken by all east coast operators, all potential ice management contractors, regulatory agencies and interested third parties. For the purposes of this report, we present below a conceptual design which may be used as a starting point in developing a functional specification.

An ice data management system for the future must not only be capable of meeting the needs of users, addressing the various styles of operators, and accommodating expected future developments in ice data acquisition and ice forecasting, but must also be designed so that:

a) the results of the previous efforts of industry and the developments of AES Ice Branch can be fully utilized;
b) a staged approach to development can continue;
c) the system can be operated in a cost-effective manner in line with the level and type of drilling activity.

Industry has expended considerable effort to date in establishing data reporting systems, common data product standards, and the development of computer systems for use in ice data managment on rigs, at shore bases, and in a central facility. With some modifications, these developments can be applied to a future system. What is generally required is a rationalization of the roles of the various system components and a reduction of the inefficiencies inherent in the systems developed in the past.

With few exceptions, the system developments sponsored by industry to date have involved a series of intensive software development projects conducted by contractors under considerable time constraints and occasionally to incomplete specifications, necessitated by virtue of the fact that planning for long term developments was not possible. The system design proposed below addresses this fact, in that it consists of a number of discrete components which can be developed in phases.

Finally, the question of cost-effectiveness must be addressed. It has been stated by industry representatives that the measure of cost-effectiveness of a product or service for exploration drilling is different than the measure employed during production drilling. Because exploration programs may be short term prospects and are subject to close financial scrutiny by the drilling partners from well to well, the development and/or use of products or services is undertaken only if a tangible economic or safety benefit is to be gained. Production programs are longer in duration and are planned in considerable detail. Required products and services are designed into the program in the planning stages and associated developments are undertaken as necessary. In both exploration and production, economic operations are required of all program components.

The measure of cost-effectiveness of ice data management system components includes the following considerations:

a) Does a particular component provide an essential service?
b) Is a particular component necessary in light of the level and type of drilling activity in progress?
c) Does a particular component contribute to the reduction of operational downtime?
d) Is the service economical and efficient to operate?

The system design described below addresses these considerations in that components are designed to provide a variety of services to more fully utilize the capabilities of an information management system, and a standard level of functionality is incorporated so that a given component may be eliminated if conditions dictate and its functions assumed by remaining components.

INFORMATION USERS

The users of ice information available through an industry ice data management program include personnel employed by industry participants, service firms contracted by the various operators, the regulatory bodies which monitor industry, and other organizations which are granted access to information by the operators. For design purposes, the following list of users will be considered:

Operators:

- supervisory personnel onboard drilling units
- environmental coordination personnel at the shore base
- drilling and logistics personnel at the shore base
- management personnel at the shore base and elsewhere
- research personnel engaged in ice-related projects

Contractors:

- ice observers onboard drilling units
- support vessel personnel

- aerial surveillance contractors
- data management contractors

Regulators:

- Canada/Newfoundland Offshore Petroleum Board
- GOGLA:
  - Ottawa

Other Organizations:

- Canadian Coast Guard
- Atmospheric Environment Service Ice Branch
- International Ice Patrol

INFORMATION REQUIREMENTS

The essential requirement of an industry ice data management program is that it must provide timely and accurate information to operator personnel - drilling and marine, offshore and onshore - in an acceptable manner as often as necessary to facilitate correct, informed decision-making in support of safe and economic operations offshore and effective management onshore. A secondary requirement is that the program address regulators' needs for ice information. Finally, the needs of significant third party interests, as agreed to by the sponsors of the program, should be met, but in such a way that there is no interference with addressing perational needs in critical ice situations.

The survey of program participants conducted during this project revealed a wide range of views regarding ice data management. In the following sub-sections, we present a rationalization of information requirements based on the totality of stated user needs.

Product List:

Two classes of data products are required:

a) scheduled products, generated at appointed times, comprising an Ice Status Report;
b) unscheduled supplementary products, updated and available to users in near real-time.

In each class there are a number of graphic and printed products.

Some general requirements are:

a) The products must be computer-generated in hard or soft copy and must be of high cartographic quality. In general, an 8.5 x 11 inch format is desireable to facilitate retransmission by telecopier. However, the option to produce products in larger formats, primarily for briefing purposes, must be available.

b) Products must be selectable and configurable by computer users via easy-to-use screen menus. Map scale and product contents are to be selectable by users.

c) Data obtained from specific sources, such as AES, IIP, CCG, or industry aerial reconnaissance, is to be viewable separately from the composite data set. That is, users should be capable of selecting a particular data product and then selecting which data set - individual source or composite - is depicted on the product. It may also be desirable to overlay data sets on a particular product for comparison purposes, or to overlay current data with data from previous years.

d) Three primary map scales are required:

i) a regional map, covering, say, 45 - 52 degrees North, 45 - 56 degrees West;
ii) a drilling area map, covering, say, 45 - 48 degrees North, 46 - 50 degrees West;
iii) site specific maps, in polar (range/bearing) form, of radius up to, say, 50 nmi from a chosen position.

By exercising scaling options, users should be able to modify the scale of each map.

Basic information depicted on maps should include coastline (with major centers noted), bathymetric depth contours (user selectable), rig/well locations and identifiers (user selectable), and vessel positions (user selectable).

e) Target positions (ice, vessels, etc.) listed on printed products should be expressible in latitude and longitude or as range and bearing from a specific location as required.

f) Ice forecasts are required, of duration up to 96 hours. Users must be allowed to select, for a particular product, the duration of forecast to be displayed, the forecast time step, and also the specific icebergs for which forecasts are desired.

g) For map products which display observed or forecast iceberg positions, the user should have the option of displaying the observed or forecast trajectory of the iceberg.

h) The title and time and space reference of each product should be clearly indicated on the product. Clear symbology should be used to depict icebergs, their size, age of observation, etc., sea ice, vessels, rig/well locations, etc. Where practical, confidence values pertaining to observation or forecast accuracy should be presented.

The core data products required of an ice data management system are listed in Table 20. The list represents the common requirements of a group of program participants as stated in 1985. It should be noted that the list represents a rationalization of the product requirements of the non-real time central facility operated in 1985. It can be argued that in a real-time system there is no need to restrict data products in any way, since modern data handling and presentation software allows rapid design and implementation of data algorithms. Specific users could then select a desired mix of products to suit the requirements of the moment. The set of products required for general distribution could be preselected.

The data products listed in Table 20 may be briefly described as follows:

GROUP 1 - OVERVIEW AND REFERENCE INFORMATION

This group of products provides overview information for industry management, logistics, and coordination personnel and reference information as a guide to product interpretation.

Product 1-1 Ice Status Report Synopsis

This product is to provide an overview of scheduled Ice Status Report contents, and should contain:

- a summary of recent reconnaissance, with an indication of the reconnaissance of greatest influence on the report;
- a summary of observed and forecast weather and sea state conditions in the drilling area, indicating any warnings in effect;

Table 20

Ice Data Management System Data Products

(P) - Printed (G) - Graphic

Group 1 - Overview and Reference Information

Product 1-1 Ice Status Report Synopsis (P)
1-2 Rig/Vessel/Aircraft Status (P)
1-3 Cross Reference of Iceberg Numbers (P)
1-4 System Usage Summary (P)

Group 2 - Observed Ice Conditions

Product 2-1 Iceberg Concentrations (G)
2-2 Regional Ice Map (G)
2-3 Drilling Area Ice Map (G)
2-4 Site Specific Ice Map (G)
2-5 Closest Sea ICe to Rig/Well Locations (P)
2-6 Iceberg Information/Trajectory (P)

Group 3 - Nowcast Ice Conditions

Product 3-1 Iceberg Concentrations (G)
3-2 Regional Ice Map (G)
3-3 Drilling Area Ice Map (G)
3-4 Site Specific Ice Map (G)
3-5 Closest Sea Ice to Rig/Well Locations (P)
3-6 Iceberg Information/Trajectory (P)

Group 4 - Forecast Ice Conditions

Product 4-1 Iceberg Concentrations (G)
4-2 Regional Ice Map (G)
4-3 Drilling Area Ice Map (G)
4-4 Site Specific Ice Map (G)
4-5 Closest Sea Ice to Rig/Well Locations (P)
4-6 Iceberg Information/Trajectory (P)

Table 20 (Cont'd)

Group 5 - General Surveillance Information

Product	5-1 Areas Searched Map (G)
	5-2 Planned Aircraft/Vessel Surveillance Messages (P)
	5-3 Planned Aircraft/Vessel Surveillance Routes (G)

Group 6 - Specific Aerial Surveillance Results

Product	6-1 Flight Log Data (P)
	6-2 Areas Searched Map (G)
	6-3 Regional Ice Map (G)
	6-4 Drilling Area Map (G)
	6-5 Site Specific Ice Map (G)
	6-6 Target Information (P)

Group 7 - Comparison Products

Product	7-1 Forecast versus Observed Ice Drift (G)
	7-2 Climatology (G)

- a summary of observed and forecast ice conditions in the drilling area, with particulars for each location of interest to users;
- recommendations regarding reconnaissance, etc., as appropriate.

Product 1-2 Rig/Vessel/Aircraft Status

This printed product is to provide up-to-date information on the location, operational status, and activity of all industry rigs, vessels, and aircraft. Typical entries in the product may include unit name, call sign, operator, time of last report, reported position, and activity. From time to time, other information, such as equipment status, may be included.

Product 1-3 Cross Reference of Iceberg Numbers

This printed product is to serve as an aid in the interpretation of iceberg information contained in other data products described below. The product should cross reference the iceberg identifiers used in these data products with the identifiers used on individual rigs and by other data providers.

Product 1-4 System Usage Summary

This printed product is to provide a list of the sponsors of the program, and the day-by-day share of the ice data management program attributed to each on some basis, (e.g. rig days) primarily for cost control and invoicing purposes when a central facility is used.

GROUP 2 - OBSERVED ICE CONDITIONS

This group of products is to present up-to-date information on observed ice conditions.

Product 2-1 Iceberg Concentrations

This graphic product is to present an overview of iceberg densities by displaying, for each grid cell determined by user selection of map scale and grid size, the number of icebergs observed in the grid cell.

Product 2-2 Regional Ice Map
Product 2-3 Drilling Area Ice Map
Product 2-4 Site Specific Ice Map

These maps are to display up-to-date position observations of sea ice and icebergs, as well as rig/well locations, vessel positions, iceberg trajectories, etc., as selected by users.

Product 2-5 Closest Sea Ice to Rig/Well Locations

This printed product is to indicate, for each rig/well or other location of interest, the range and bearing from the location to the nearest point on the observed sea ice edge.

Product 2-6 Iceberg Information/Trajectory

This printed product is to be used primarily to display, for all or selected active icebergs, the last observed information for the iceberg, including number, last observed position, time of observation, source of observation, size, shape, and dimensions, etc. As an option to users, the observed trajectories of all or selected icebergs are to be displayed, including time, position, speed, and course.

GROUP 3 - NOWCAST ICE CONDITIONS

This group of products is similar in form and contents to Group 2 products. The primary difference is that, whereas ice positions depicted in Group 2 products are those most recently observed, the ice positions depicted in Group 3 products are nowcast positions estimated to be accurate at either the time the product is generated or at some preset "valid time." For example, Product 3-1, Iceberg Concentrations, is identical to Product 2-1 except that the numbers displayed in the grid cells represent the number of icebergs estimated to be present in the area at the time to which the nowcast applies, rather than the number observed at some earlier time.

A nowcast position is derived by applying a drift forecasting model to the most recent observed position and using observed environmental parameters to derive drift values for the time between the observation and the present (i.e. the valid time of the nowcast). The forecast model can then be applied to the nowcast position and using forecast environmental parameters as driving forces, an ice drift forecast can be derived.

GROUP 4 - FORECAST ICE CONDITIONS

Again, this group of data products is similar to the Group 2 and Group 3 products. The primary difference is that ice positions in Group 4 products are forecast positions. For example, Product 4-1 Iceberg Concentrations, refers to the number of icebergs forecast to lie in the pre-defined grid cells at some point in the future. Users must have the option to select forecast duration and time step, display of data for all or selected icebergs, and display of observed and nowcast positions in addition to forecast positions.

GROUP 5 - GENERAL SURVEILLANCE INFORMATION

This group of products is to assist in the evaluation and planning of ice reconnaissance, and should incorporate industry and non-industry information.

Product 5-1 Areas Searched Map:

This map of variable scale is to depict the routing and areas covered by industry, AES, and IIP reconnaissance aircraft and vessels. In addition to selecting map scale, users are to be permitted to select the number of days (1-5) reconnaissance coverage is to be presented.

Product 5-2 Planned Aircraft/Vessel Surveillance Messages

This printed product is to list information regarding planned ice reconnaissance by industry, AES, and IIP. The product should incorporate the AES/IIP flight messages, industry flight notices and vessel routing reports.

Product 5-3 Planned Aircraft/Vessel Surveillance Routes

This map, of variable scale, is to depict the planned routes of aircraft and vessels to be assigned to ice reconnaissance. The unit call sign and planned timing should be indicated.

GROUP 6 - SPECIFIC AERIAL RECONNAISSANCE RESULTS

This group of products is to be used to examine the results of specific aerial reconnaissance flights by industry, AES, and IIP.

Product 6-1 Flight Log Data

This printed product is to list aircraft and visual/radar parameters recorded inflight, including time of takeoff/waypoints/landing, position, altitude, radar settings, significant events, etc.

Product 6-2 Areas Searched Map

Similar to Product 5-1, this product is to depict the route and area covered by the particular flight.

Product 6-3 Regional Ice Map
Product 6-4 Drilling Area Ice Map
Product 6-5 Site Specific Ice Map

These products are identical to Products 2-3, 2-4, and 2-5, except that only data collected during the single flight is displayed.

Product 6-6 Target Information

This printed product is to list information regarding visual/radar targets detected during the flight. Target number, type (if known), source of information (radar, visual, or both), time, position, and size information, etc., are to be included.

GROUP 7 - COMPARISON PRODUCTS

This group of products may be useful in assessing the reliability of forecast models or examining the relationships between current ice conditions and those of previous years.

Product 7-1 Forecast versus Observed Ice Drift

This graphic product, to be available on various user-selectable scales, would depict, for selected icebergs or for pack ice, the observed trajectory or position, and the trajectory or position forecast earlier.

Product 7-2 Climatology

This graphic product, to be available on various user-selectable scales, would depict present ice conditions as well as those recorded previously, say one week, month, or year ago. (This concept can be implemented only if the required comparison data is available in the system).

Timing: Based on the survey of program participants in 1985, it was concluded that the availability of certain data products is required on a more-or-less continuous basis, especially during critical ice situations. In addition, certain products are required on a scheduled basis, as part of formal ice status reports.

If the data management facility is operated on a 24 hour per day basis, at least two ice status reports will be required per day. All products are to be updated to this schedule. Products which include raw or observed data (ice information, vessel status, flight messages) are to be updated as new information becomes available. Products which depend on nowcast or forecast ice conditions are to be updated as new ice observations are input and as new environmental observations and forecasts are made available (e.g. every 6 hours).

Means of delivery: To address the various operating styles, preferences, the capabilities of information users, and the nature of the ice data management system (i.e. centralized versus decentralized) data products may be delivered by a number of means, including an on-site computer system, remote workstation or telecopier.

Product distribution list: Because an ice data management program for industry is a private program, its users and the information they receive are determined by the industry participants who control the program. For the purposes of this report, the assumed distribution list has been compiled on the basis of the user survey.

a) Industry participants would have continuous access to all data products.
b) Industry contractors would have access to certain data products as designated by the opertors.
c) Regulators would receive the following products on a daily basis:
   Product 2-3 Drilling Area Ice Map - Observed
   Product 2-6 Ice Information/Trajectory - Observed
   Product 5-1 Areas Searched Map
d) Under the SOLAS convention, CCG would receive ice observation data obtained by industry vessels as the information was acquired.
e) AES and, via AES, the IIP would receive digital data on observed ice conditions and industry surveillance on a regular basis during the ice season. It should be noted that industry prefers a "one window" approach to industry-government data exchange, and because the data exchange is not formal a requirement, it must be conducted on the basis of no interference with drilling and ice response operations.

INFORMATION SOURCES

Raw and processed ice data is presently available from a variety of sources via a number of means. In future, the deployment of satellite-based sensors (e.g. RADARSAT) and communications satellites (e.g. MSAT) will result in increased data availability and improved means of delivery. The present and anticipated sources, types, volumes, frequencies, and means of delivery of data are discussed below.

Types of data will be summarized as:

Ice data - including time, iceberg position and dimension reports, sea ice position and description reports, etc., and position reports for unknown targets, ships, drifter buoys, and the like;

Environmental data - including weather and sea state observations, analysis and forecasts, oceanographic observations and analysis, etc.

Status data - including vessel and aircraft position and equipment status reports, aircraft flight parameters, etc.

Volume of data refers to the number of bytes (characters) of information transmitted in a single report, and will be referred to as:

- low, indicating tens of bytes
- moderate, indicating hundreds of bytes
- high, indicating thousands of bytes
- very high, indicating millions of bytes

Frequency refers to the number of reports transmitted each day, week, etc.

Industry vessels collect and report ice and some environmental data as required to support operations and file routine status reports. Data volume is typically low but increases with ice severity. Similarly, frequency can range from 0 - 24 times per day. At present, vessels report information by radio voice transmission to a rig or shore base. With an increased communications capability, it is likely that digital transfer via satellite or HF radio will be utilized, at least on some vessels.

Industry helicopters report inflight status on a routine basis and ice data on an opportunity basis. Data volume is low and frequency is normally once per flight, i.e. once per day. Reports are now, and will likely continue to be filed by radio voice transmission to a rig or shore base. If a helicopter is deployed from a rig to peform ice reconnaissance, a paper record of observations and flight path is delivered to the rig upon flight completion.

Industry fixed-wing aircraft dedicated to ice reconnaissance report ice and status data. Data volume can be high, depending on prevailing ice conditions. Frequency ranges from 2-10 times per week. Information is transmitted to the ice data management computer(s) via computer-to-computer link.

Rigs report ice data, environmental data, and status data on a routine basis. Data volume may generally be considered as moderate. Frequency is hourly for some data, and several times per day for other data. Data may be transmitted via telecopier, voice or computer-to-computer.

Industry service contractors (weather, flight following) transmit environmental and status data to the operators. Data volume is low to moderate and frequency ranges from two to six times per day. At present, data is transmitted via telex and telecopier, although the use of computer-to-computer links is feasible.
AES transmits a variety of ice data including flight results, charts, etc., to the general community. Data volumes are high. Frequencies are generally daily. Through the use

of Ice Branch systems such as BAPS, IDIAS, etc., digital links can be established for information exchange. AES also handles IIP and CCG data.

Environment Canada weather services and the Canadian Forces METOC Centre transmit a variety of environmental data to the general marine community. Data volumes are moderate to high and frequencies several times per day. It is now possible to establish digital links to obtain this data.

INFORMATION MANAGEMENT

The term information management is used here to refer to the functions necessary to obtain data from the sources discussed above and use it to generate and distribute the data products required by users. These functions include:

- data acquisition
- quality control
- analysis and synthesis
- processing
- ice forecasting
- archiving
- retrieval
- data product generation and distribution.

Ice information managment occurs at three levels: Site-specific (tactical) information management is performed on each drilling unit by ice observers. On the majority of drilling units, a combination of manual and computerized methods are used to perform the functions listed above. However, on some drilling units only manual methods are used. At each operator shore base, some level of site-specific information management is performed by environmental department personnel. The methods employed are often similar to those used offshore, although shore base personnel may have access to more computing resources.

Area-specific (strategic) information management is generally performed on shore. In 1984 and 1985, industry contracted the operation of a central data management facility to serve all operators. Since 1986, operators have used computer systems in each shore base. These systems could be used to exchange data as required.

Regional information management is performed by AES Ice Branch in cooperation with CCG and IIP. All relevant information is processed at Ice Central in Ottawa and numerous data products are distributed.

An ice data management program for the future must be flexible enough to accomodate the various forms of information management, and the level and nature of drilling activity.

For the land-based components of an ice data management system, the choices regarding the type of system used are a) a central facility linked to workstations in all the shore bases, and b) a decentralized system consisting of self-contained computer systems in the shore bases with computer-to-computer links to facilitate data transfer.

A centralized system has the following advantages:

- It can be a cost-effective solution to the common ice data management requirements of several operators working in relatively close proximity.
- It provides for a consistent service which remains stable despite the arrival and/or departure of individual operators.
- It provides an effective focal point for information exchange between industry and such non-industry organizations as AES, CCG, and IIP.
- It provides data products which industry can use collectively to meet regulatory needs.

The disadvantages of a centralized system include:

- It is not cost-effective if too few operators participate, or if ice conditions do not warrant the level of service prescribed.
- Because the system is for the common use of all operators, it may not meet the specific needs of individual operators.
- Because the system is shared, resources are never dedicated to one operator only, whereas certain operators desire this.
- Unless the system has direct links with data sources, it is sufficiently removed from operations to cause time delays in data delivery as well as data quality control difficulties.
- Problems arise in segregating data when data acquisition costs are not shared by all participants.

The advantages of a decentralized system include:

- It is well-suited to a one or two operator program in which one operator can assume many of the functions of a central facility.
- The decentralized system units are in direct contact with operations personnel and communications and other operational support systems, resulting in better quality control of data.
- All resources are dedicated to the specific needs of one operator and are not diluted by dividing available resources among a group of operators.
- Each subsystem can be an independent, stand-alone unit easily customized to meet the specific needs of the operator.

The disadvantages of a decentralized system include:

- The development of individual subsystems is dependent on the individual operators who wish to participate, so that joint system specifications regarding data exchange formats, communications protocols, etc. are necessary to achieve the objectives of joint ice management.
- One operator must assume responsibility for liaison with AES/IIP/CCG. Because of occasional differences between operators in operating philosophy, dependence of one operator on another may pose a problem. Also, continuity is greatly affected by changes in drilling programs, e.g. the participant responsible for non-industry liaison may discontinue drilling.
- The increased costs associated with an expansion of a totally decentralized system may outstrip the costs of a centralized system. For example, the total cost of development and operation of IDMS-85 was approximately $450,000, shared among four operators in a heavy ice season; in 1986, a relatively light ice season, one of the operators who used a system at the shore base paid approximately $200,000 for development and operation of the system.

In light of the low level of drilling activity experienced in recent years and the likelihood that this low level will continue, the choice of whether to use a centralized or decentralized system appears to be weighted heavily on the side of the decentralized system.

A key requirement in designing a decentralized system is that industry utilize a standard set of specifications when contracting the development of ice data management computer systems for use on rigs and on shore. If the core functions of such systems are standardized, the flexibility of the overall ice data management program is enhanced through the ability to transfer software, and hence subsystem functionality. It is recognized that because agreement among many parties can often be difficult, priorities should be established regarding which functions to standardize. This will be discussed in Section 7.

The features of this design may be summarized as follows:

a) Each operator maintains a self-contained tactical ice data management program whereby field sources collect data which is managed at each rig. Information is exchanged with the shore base, which in turn exchanges information with other operators.

b) One operator is designated as the contact point for non-industry data sources, and distributes non-industry data to the other operators.

c) Operators jointly sponsor fixed-wing aircraft reconnaissance and flight/vessel following. Data exchange with these contractors is conducted at each shore base.

The following subsystems would be required:

i) Each rig would house a suitable computer system which would be used for tactical ice data management and linked, via a suitable communications system, to the shore base of the rig operator.
ii) Each shore base would house a suitable computer system linked to the rig and to similar systems at the other shore bases. The system would have the capability to exchange data with the rig, with other operators' systems, with the system onboard the reconnaissance aircraft, with AES, etc.
iii) Industry contractors for ice reconnaissance and weather forecasting would exchange data with the shore bases via computer-to-computer link.
iv) AES Ice Branch, Environmental Canada Weather Services, and the METOC Centre would maintain computer-to-computer links with a designated shore base. CCG and IIP data would be routed through AES.

Rig systems must essentially perform two functions:

i) assist rig-based personnel performing duties associated with tactical ice data management;
ii) facilitate information exchange with shore base.

The computer hardware and software comprising the systems must be capable of the following:

a) accommodating at least two simultaneous users;
b) executing multiple tasks simultaneously (e.g. accepting data from the ice observer, receiving data transmitted from shore base);
c) performing the various functions associated with tactical ice data management (data entry, quality control, archiving, ice forecasting, etc.) quickly and reliably, via a user-friendly operator interface;
d) transmitting tactical data to shore base via a digital interface, including an RS-232 computer interface;
e) producing high quality graphic and printed data products.

In terms of equipment, it is anticipated that an adequate rig system would include at least the following:

- a microcomputer with a multi-user, multi-tasking operating system such as Unix;
- one operator terminal, with capability to add others;
- appropriate output devices (printer, plotter, etc.);
- at least one communications interface (e.g. RS-232) to be used for remote data communications using satellite or other technology.

Shore base systems must have capabilities similar to the rig systems, with special emphasis on the production of high quality output and effective data communications. The equipment used in a shore base system would also be similar to that used on a rig. More and better output devices will likely be required, and an increased number of data communications lines (both satellite and terrestrial) will be necessary. The system will be required to perform a variety of tasks concurrently. In addition, the system must provide the operator with an extensive set of tools to assist in managing a high volume of data of varying quality, received from a number of sources. These tools would include effective data capture and quality control procedures, sophisticated data analysis and presentation/manipulation hardware and software, and high quality output devices.

Although present and expected short term future activity on the Grand Banks suggest that a decentralized system may be more appropriate, the view that a centralized system should be established can be argued, for the following reasons:

1. Operators can and do disagree, in both overall approaches and in day-to-day situations. In a true "joint ice management" situation, proper sharing of accurate, quailty-controlled data is essential to safety. Because the decentralized system would involve operators with different approaches to ice management in general, different operating hours of the data management centre, etc., this proper sharing of data may be difficult to achieve. Also, the frequent telephone calls required between shore bases in a decentralized system often become aggravating to radio room staff and at times reduce their desire to respond in a cooperative manner. It is therefore suggested that central facility, staffed on a 24 hour basis, and having full quality control capability, would permit the required sharing of data, electronically, on a 24 hour per day basis. Each operator could operate his shore base facility according to his own style, but would have complete access to other operators' ice data without having to issue specific requests.

2. The concept of having each operator build his own shore base system to meet a given specification may be difficult to achieve. One reason for this is that the operators have different approaches to contracting the services required to develop and operate these systems - some

prefer longstanding relationships with selected contractors while others prefer to change contractors periodically. A second reason is the changing situation with the contractors themselves: in 1985, there were at least four contractors competing for the work and at least fifty qualified personnel to perform the work; as a result of the downturn in the oil industry, some of the contractors have left the scene (often taking with them the systems developed for operators, since no ownership provisions were contained in the contracts), and many of the qualified personnel available in 1985 have taken up other occupations. A third reason relates to the differences among system development contactors, regarding hardware and software preferences and regarding the capabilities of the software developers involved.

If the approach to development of a decentralized system which began during the downturn of 1986 has to be expanded, it is possible that "the wheel will be re-invented" over and over again by different operators, and the result will be shore base systems ranging from excellent ones to unacceptable ones, with a subsequent impact on effective data sharing.

Therefore, it is proposed that a central facility, developed and operated under the supervision of an appropriate industry "agency" rather than a coalition of currently operating companies, could more effectively meet industry needs in future. The centralized system proposed would bear considerable likeness to the decentralized system described above, in the sense that rig systems and shore base systems would require similar capabilities, although it would be possible to downgrade the shore base systems somewhat due to descreased requirements for data management and communications.

Each operator would still maintain a self-contained tactical ice management program on rigs. Information would be automatically forwarded to shore base, which would then automatically retransmit the data to the central facility rather than communicate with other shore bases. The central facility would rationalize and quality control all industry data, would act as the contact point for external data sources, and would be the receptor of industry airborne ice reconnaissance data. The primary function of the central facility would be to provide quality controlled data from all sources to the operators via digital data links on a 24 hour per day basis throughout the ice season. The systems in the shore bases could then be used to present the data for use by management and to retransmit data required by the rigs.

The resources required to operate the central facility would include:

- a multi-user, multi-tasking computer system
- multiple data communications channels (8-16 minimum)
- a minimum of two operator workstations

- appropriate output devices
- appropriate communications facilities (e.g. HF radio)
- at least six qualified staff, including a manager
- support/service staff
- additional staff to serve in shore bases as required

Other resources which could be made available by the operators might be the systems for use at shore bases and on rigs. These could be customized to address the specific needs of individual operators while maintaining the necessary compatibility with the central system. The operator of the central facility may also maintain a pool of personnel who could be contracted to operate the rig/shore systems of individual operators. Finally, the central facility could also have a full communications capability to enable voice and data communications with all elements of the ice data management network.

If such a facility were developed and operated under the auspices of an industry-owned, independent organization similar to Eastcoast Spill Response Inc., for example, the following would be achieved:

1. Any operator choosing to drill on the Grand Banks could avail of an industry-owned system which fulfilled the requirements of joint ice management. The operator would not have to be concerned about the capabilities of existing ice data management contractors to provide systems which met those requirements.

2. A turnkey system would be in place capable of accommodating any number of operators. The system could be put into operation on relatively short notice without the need to enter into discussions with service contractors. Operators could be added or removed from the system easily as they arrived or departed the scene without affecting the cooperative arrangements of the joint ice management plan.

3. The system would be a solid foundation upon which to build as improvements were required to accommodate oil production projects, improvements in data communications and data processing technologies, etc.

7.0 CONCLUSIONS AND RECOMMENDATIONS

Based on an independent analysis of IDMS-85 and a survey of 1985 program participants, it is concluded that the system developed by industry in response to regulatory guidelines/directives was generally adequate, but did nnot meet all the specific needs of individual operators. Whereas the system was designed to serve four operators with a total of six rigs in 1985, it was not cost-effective in situations which existed in 1986, 1987 and 1988, when only one or two operators were active on the Grand Banks. Since 1986, the active operators have implemented individual ice data management systems for use at each operator's shore base. The two systems used in 1988 were developed and operated by different contractors to the specifications of the respective operators. Through the use of standardized data reporting formats and popular communications software, each system could communicate with the other, with the fixed-wing aircraft surveillance system, and with AES systems, and thus achieved the information exchange objective of joint ice management.

One of the objectives of this study was to recommend a reliable, effecient and cost-effective ice data management system for the future. In light of the efforts of industry to date in developing common data reporting standards, effective ice surveillance methods, high quality data products, and interconnected computer systems at shore bases, the systems used since 1985 appear to have satisfied operators' requirements. However, the industry downturn that began in 1986 has resulted in a significant reduction in the number of systems available and in the number of personnel available to develop and operate such systems. It is expected that a resumption of winter drilling on the Grand Banks and/or the initiation of production programs will require the development of new systems and the training of new personnel. The key question to be resolved prior to undertaking system development is whether to build a decentralized system or a centralized system.

Based on a study of the relative advantages and disdvantages of centralized and decentralized systems, and on the personal experiences of the authors in the development and operations of both types of systems, it is concluded that a centralized system, developed and operated under the control of an industry-owned body, would best serve the long-term needs of industry.

It is recommended that:

1. Industry, through the Canadian Petroleum Association, establish an organization to coordinate the development and operation of an industry-owned ice data management system for the Grand Banks.

2. The organization establish a committee comprised of representatives from industry, regulatory bodies, Atmospheric Environment Service Ice Branch and significant third parties to establish data communica-

tions standards and the like, and to develop a detailed specification for the central system and systems for use in shore bases and on rigs.

3. The organization procure the goods and services involved in acquiring a fully-tested, operational system consisting of a central system, a data communications system and at least one shore base system and one rig system.

4. The organization develop a comprehensive training program in all aspects of ice management, ice data management and systems operations, and train a team of personnel who would be employed on a seasonal basis as required.

Given that any future ice data management program will rely heavily on an effective communications system, either dedicated to ice data management or also used for other purposes, used by a single operator or shared between several, or aimed at minimizing either capital or operating costs, the following points must be considered:

- the objectives, performance requirements, and long term needs for the data communications system should be clearly defined before planning or implementation;

- detailed systems engineering should be performed, taking into account objectives, uses, architecture, protocols, current equipment, future locations, and the like.

The data communications system will include a shore-to-shore component, a rig-to-shore component, and possibly rig-to-rig and vessel-to-rig components. The shore-to-shore component can be readily addressed through the use of dedicated or dial-up telephone links, DataPac, and the like. It is the offshore communications aspect which requires careful study.

A shared satellite data link offering wide coverage to all operators for all data communications requirements, not just ice data management, and not limited merely to Grand Banks, could well be the most cost effective future approach to offshore data and voice communications requirements. Such a multiple user network would require a high level of security, and this is readily available through "off the shelf" data encryption systems using either the so called "public key" approach or the Data Encryption Standard (DES).

Other systems which may be appropriate for some aspects of offshore data communications include high-powered HF radio data communications systems such as that offered by SeaLink, and the low-powered HF data terminal systems designed by the federal

Department of Communications and used by the Department of Fisheries and Oceans. The former offers a service in competition with satellite services and could be used for rig-to-shore and rig-to-rig communications. The latter is designed for low data rate, low data volume applications and may be appropriate for vessel-to-rig and vessel-to-shore use.

In addition to data communications requirements, a number of computer systems will be required to establish the various ice data management facilities. The specifications for these systems should include descriptions of the requirements regarding:

- number of users
- number and nature of concurrent tasks
- data reporting and archiving
- quality control
- ice forecasting and forecast verification, including a list of acceptable models and error levels
- data products
- user interface
- communications and data exchange protocols
- acceptable computer hardware
- acceptable programming languages
- acceptable graphic languages.

Once the detailed system specifications have been established, industry should allow the development team sufficient time to produce a fully tested and debugged operational system. The system could then be "mothballed" by industry until such time as it was required.

To summarize, it is concluded that the most effective ice data management system to support future operations on the Grand Banks would be a centralized system utilizing the latest in data communications and data processing technology. The system should be owned and operated by industry, and developed in an orderly fashion to a detailed specification established by industry, with participation by other parties as appropriate.

APPENDIX A

EXAMPLES OF IDMS INPUT DATA FORMATS

FEB.23 '85 10:29 H.I (FLD.

RIG ICE REPORT

: SHORE BASE
: 1. TELECOPIER (Preferred) 2. TELEX 3. VOICE

cc : ICE CO-ORDINATOR
ICE INFORMATION CENTRE

DATE : 23 Feb 1985

ROM JOHN KELLAND 2 RIG BDZ 3 WELL NAME ARCHER K-19 4 TIME OF REPORT 0940 LOCAL 0745 LOCAL

5 TIME (G.M.T.)	6 RANGE N.MILES	7 BEARING TRUE NORTH	8 ICEBERG NUMBER	9 TYPE OF ICE	10 LENGTH	11 WIDTH	12 HEIGHT	13 DRAFT	14 SOURCE OF SIGHTING	15 DRIFT SPEED AND HEADING
00	31.1	016.5	005	BERG	X	X	X	X	SEA FORTH ATLANTIC	SEE COMMENTS
20	+ 31.9	016.4	005	DDOCK	84	78	34	E 110	"	0.6 KT TO 012°

ENTERED CCR ? 4 1985

FEB 23 1985

MMENTS Between 2130 Z To 0830 Z DRIFT 0.6 KTS AT 126°
Between 0830 Z To 0930 Z DRIFT 0.8 KTS AT 012°
* 18.2 at 092° T FROM CONQUEST. + 18.32 @ 89.9

FEB 23 198
0956

POSITION (IF OFF WELLSITE): LATITUDE ____ ° ' " N LONGITUDE ____ ° ' " W

RT STATUS :

ICE ALERT ZONE AT TIME OF REPORT ______ ZONE
FORECAST ICE ALERT ZONE IN 12 HOURS ______ ZONE
FORECAST ICE ALERT ZONE IN 24 HOURS ______ ZONE
T TIME ______ HOURS
FORECAST CPA OF CLOSEST BERG
CPA : TIME/DATE ______ RANGE ______ BEARING ______
RRENTS : SPEED ______ DIRECTION ______
WIND : SPEED ______ DIRECTION ______
(WHEN AVAILABLE)

TOWING OPERATIONS :
21 BOATS AVAILABLE FOR TOWING ______
22 BOATS TOWING ______
23 ICEBERGS BEING TOWED # ______ # ______
24 DIRECTION OF TOW ______ ______
______ # ______

25 APPROVED BY : ______
OPERATORS SENIOR REPRESENTATIVE

P.01

Figure A-1. Industry Rig Ice Report

GRAND BANKS OPERATORS JOINT ICE MANAGEMENT PLAN

VESSEL ICE REPORT

MV / BOLTENTOR

A. VESSEL DATA

1 DATE	85Ø614	MONTH / DAY
2 TIME	233oZ	HOUR / MIN.
3 CALL SIGN	CYOFF	OF VESSEL
4 LATITUDE	4736.6	PRES. POS'N. OF VESSEL
5 LONGITUDE	4855.5	PRES. POS'N. OF VESSEL
6 SPEED/COURSE	1.2Ø4Ø	KNOTS / DEGREES
7 RADARS	R6R3R	EFFECTIVENESS
8 WEATHER CONDITIONS	XXØ76	VIZ. / SEAS (Feet) / WX
9 ICE SIGHTED	YYICE	YY=YES NO=NO

B. ICEBERG DATA (For each target sighted complete Sections B1, B2, B3, etc.)

B1

10 BERG NUMBER	N1424	NUMBER OR XXX
11 ICEBERG	SBPNC	SIZE / SHAPE
12 BERG LENGTH	LEØ25	M/E/X / METRES
13 BERG WIDTH	WEØ15	M/E/X / METRES
14 BERG HEIGHT	HEØ1Ø	M/E/X / METRES
15 BERG DRAFT	DXXXX	M/E/X / METRES
16 BERG POSITIONING	NAVØ3	ACCURACY
17 LATITUDE	4736.6	ICEBERG POSITION
18 LONGITUDE	4855.5	ICEBERG POSITION
19 TIME OF	233ØZ	ICEBERG POSITIONING
20 TOWING	TOWØ2	ASSESSMENT
21 BERG TOWING	YYMØ1	YY=YES NO=NO / METHOD
22 TOWING SPEED/COURSE	1.2Ø2Ø	KNOTS / DEGREES
23 BOLLARD PULL	BPE55	M/E/X / TONS

NEAREST RIG ______ CALC. BEARING FROM RIG TO BERG ØØ1 °T RANGE 41 NM

B2

10 BERG NUMBER		NUMBER OR XXX
11 ICEBERG		SIZE / SHAPE
12 BERG LENGTH	L	M/E/X / METRES
13 BERG WIDTH	W	M/E/X / METRES
14 BERG HEIGHT	H	M/E/X / METRES
15 BERG DRAFT	D	M/E/X / METRES
16 BERG POSITIONING	NAV	ACCURACY
17 LATITUDE		ICEBERG POSITION
18 LONGITUDE		ICEBERG POSITION
19 TIME OF	Z	ICEBERG POSITIONING
20 TOWING	TOW	ASSESSMENT
21 BERG TOWING	M	YY=YES NO=NO / METHOD
22 TOWING SPEED/COURSE		KNOTS / DEGREES
23 BOLLARD PULL	B	

NEAREST RIG ______ CALC. BEARING FROM RIG TO BERG ______ °T RANGE ______ NM

B3

10 BERG NUMBER		NUMBER OR XXX
11 ICEBERG		SIZE / SHAPE
12 BERG LENGTH	L	M/E/X / METRES
13 BERG WIDTH	W	M/E/X / METRES
14 BERG HEIGHT	H	M/E/X / METRES
15 BERG DRAFT	D	M/E/X / METRES
16 BERG POSITIONING	N	ACCURACY
17 LATITUDE		ICEBERG POSITION
18 LONGITUDE		ICEBERG POSITION
19 TIME OF	Z	ICEBERG POSITIONING
20 TOWING	TOW	ASSESSMENT
21 BERG TOWING	M	YY YES / METHOD
22 TOWING SPEED/COURSE		KNOTS / DEGREES
23 BOLLARD PULL	B	

NEAREST RIG ______ CALC. BEARING FROM RIG TO BERG ______ °T RANGE ______ NM

COMMENTS ______

C. PACK ICE REPORT

TO BE TRANSMITTED BY VERBAL DESCRIPTION ALONG WITH SECTION A ABOVE.
PARAMETERS REQUIRED: CONCENTRATION, THICKNESS, FLOE SIZE, POSITION, ORIENTATION, EXTENT, DRIFT SPEED & DIRECTION

Revised Nov. ,1984

Figure A-2. Industry Vessel Ice Report

DATE Apr 9 1985

ACK ICE REPORT FROM M/V Gabarus Bay

REPORTED TO RIG BY RADIO AT 2040 L / 0840 L

SHIP POSITION	TIME	LAT. N.	LONG. W.	CONCENTRATION (TENTHS)	THICKNESS (INCHES)	FLOW DIAMETER (FEET)	DRIFT SPEED (KNOTS)	DRIFT DIRECTION (DEGREES T)	SHIP SPEED MAINTAINED THROUGH ICE (KNOTS)	ARE FLOES EASILY BROKEN * (YES OR NO)
1	1200Z	47.03.2	48.02.4						5.5/220T	
2									wx conditions 10101	
3	2100Z	4708.3N	48.03.9	6/10	1st yr 2/10 sm floe	4/10	Brash		2K. /100T 01063	yes
4	0000/09Z	47 05.9N	4805.9N	1/10	1st year 5/10 Small Flow	3/10 Ice Cakes 2/10 Brash			wx Condition XX062 240°/1.5KTS.	NO
5										
6										
7										
8										
9										
10										

* FLOES BROKEN WITHOUT RAMMING

Figure A-3. Industry Vessel Pack Ice Report

,M/03D 11:10 HUSKY BOW VALLEY ST. JOHN'S NFLD

AERIAL ICE

INDUSTRY HELICOPTER RECONNAISSANCE REPORT - page 1 — June 85

AIRCRAFT: Puma	REGIST		
PILOT: B. Jarvis	CO-PILOT: Bartlet		REPORT: 033
OBSERVER: P. Rudkin	OTHER:		SHEET 1 OF 3
DEPARTURE: BD2 @ 1920 Z	ARRIVAL: BD2 @ 2108		AIR TIME: 1.8
FLIGHT ROUTE: as Indicated			
CONTINUOUS RADIO COMMUNICATION WITH FLIGHT FOLLOWING ☑			☐ SEE REMARKS
INFLIGHT REPORT: TO Bow Drill 3			

	No.	ICE/BERG - SIZE/TYPE	TIME(Z)	POSITION LAT.	POSITION LONG.	COMMENTS PHOTO/ALT.	COMMENTS BRG./DIST. FROM
1318	1	Small Pinnacle	1936	47 16	48 10		
1319	2	Small Blocky	1938	47 19	48 16	Video @ 500'	
~~1320~~	~~3~~	~~Bergy B.T.~~	~~1940~~	~~47 21~~	~~48 23~~		
1320	4	Small Pinnacle	1942	47 12	48 30		
1321	5	Medium Tabular	1944	47 27	48 38	Video @ 500'	

No other bergs to run as located

ENTERED JUN 0 3 1985

RECORDED JUN 0 3 1985

CLOSEST ICEBERG(S) SIGHTED: # 2	BRG: 356 °T	8 N.mi FROM: BD2	
CLOSEST PACK ICE SIGHTED: Nil	BRG: °T	N.mi FROM:	
TOTAL No. OF SIGHTINGS: 4 BERGS	Ø SHIPS	— UNCONFIRMED	
PREVAILING VISIBILITY: 15 +		AVERAGE ALTITUDE: 500' ASL	
VIDEO TAKEN ☑ TAPE # 27-27	PHOTOS TAKEN ☐	TOTAL No.	

REMARKS

All Berg Positions are Estimated

RECORDED JUN - 3 1985

FENCO

Figure A-4. Industry Helicopter Reconnaissance Report - Page 1

06M/03D 11:1 HUSKY BOW VALLEY ST JOHN'S NFLD

ICE RECONNAISSANCE MAP

PAGE 2 OF 3	REPORT NO: 033	REF: NIL	DATE: 02- JUNE 85

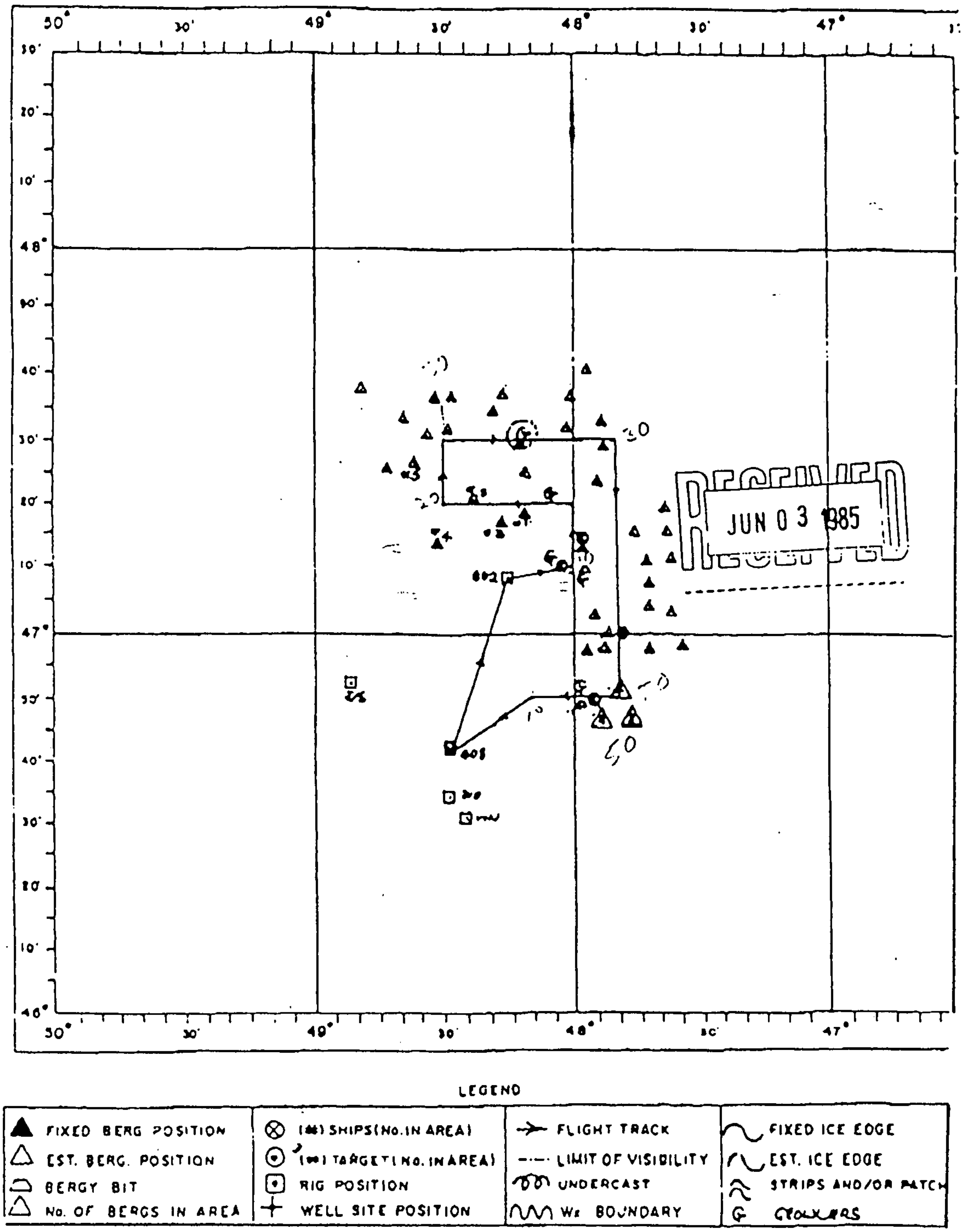


Figure A-5. Helicopter Visual Reconnaissance Map - Page 2

AERIAL ICE RECONNAISSANCE

AIRCRAFT: King Air B-200	REGISTRATION: C-GPCD	DATE: 29 Jun 85
PILOT: G. Ollerhead	CO-PILOT: D. Power	REPORT: 001
OBSERVER: Glyn Snow	OTHER:	SHEET 1 OF 4
DEPARTURE: YYT @ 1259	ARRIVAL: YYT @ 1742	AIR TIME: 4.9
FLIGHT ROUTE: Modified Route 9		
CONTINUOUS RADIO COMMUNICATION WITH FLIGHT FOLLOWING ☑		☑ SEE REMARKS
INFLIGHT REPORT: BD2, "Closest Ice Berg #21 under tow by HBV Supply Vessel"		

No.	ICE/BERG - SIZE/TYPE	TIME(Z)	POSITION LAT.	POSITION LONG.	COMMENTS PHOTO/ALT.	BRG./DIST. FROM
1	(6) Bergs 1630	1336	48 05	48 49	Est. Position	
2.	Large Drydock 1622	1341	4746	49 24	" "	
3.	(5) Bergs 1631	1344	48 12	49 06	" "	
4.	Medium Drydock 1619	1352	48 06	48 36	2/35mm 500', Fixed Position	
5.	Small Berg 1632	1352	48 16	48 36	Est. Position	
6.	Medium Dome 1633	1354	48 02	48 25	2/35mm 500' Fixed Position	
7.	Medium Drydock 1618	1354	4757	48 25	Est. Position	
8.	Medium Drydock 1628	1358	4745	48 08	" "	
9.	Small Berg 1634	1358	4735	48 08	" "	
10.	Medium Berg 1627	1401	4802	4755	" "	
11.	Small Berg 1635	1410	4748	4718	" "	
12.	Small Drydock 1636	1411	4800	4713	Fixed Position	
13.	(2) Small Bergs 1637	1414	4802	4700	Est. Position	
14.	Small Drydock 1638	1419	4746	4652	" "	
15.	Medium Berg 1639	1421	4746	4652	" "	
16.	(2) Small Berg 1640	1421	4740	4637	" "	
17.	Small Drydock 1641	1425	4730	4657	" "	
18.	Small Berg 1642	1431	4722	4722	" "	
19.	Small Berg 1643	1433	4720	4725	" "	
20.	(5) Bergs 1644	1439	4730	4745	Fixed Position	
21.	Bergy Bit 1616	1444	4721	4750	4/35mm 300'	
22.	Medium Berg 1607	1453	4730	4807	3/35mm 300' Fixed Position	
23.	Small Berg 1621	1453	4730	4807	Fixed Position	

CLOSEST ICEBERG(S) SIGHTED: See Sheet 2.	BRG: °T	N.mi FROM:	
CLOSEST PACK ICE SIGHTED:	BRG: °T	N.mi FROM:	
TOTAL No. OF SIGHTINGS:	BERGS	SHIPS	UNCONFIRMED
PREVAILING VISIBILITY:		AVERAGE ALTITUDE:	
VIDEO TAKEN ☐ TAPE #	PHOTOS TAKEN ☐	TOTAL No.	

REMARKS

1 - (2) Bergy Bits and numerous growlers in area of #20 (5) Bergs
2 - Bergy Bit #21 under tow by HBV Supply Vessel.
3 - HBV Supply Vessel standing by Bergs #22 + 23

Con't Sheet 2

Figure A-6. Industry Visual Reconnaissance Iceberg Report

PAGE 3 OF 4 | REPORT No: 001

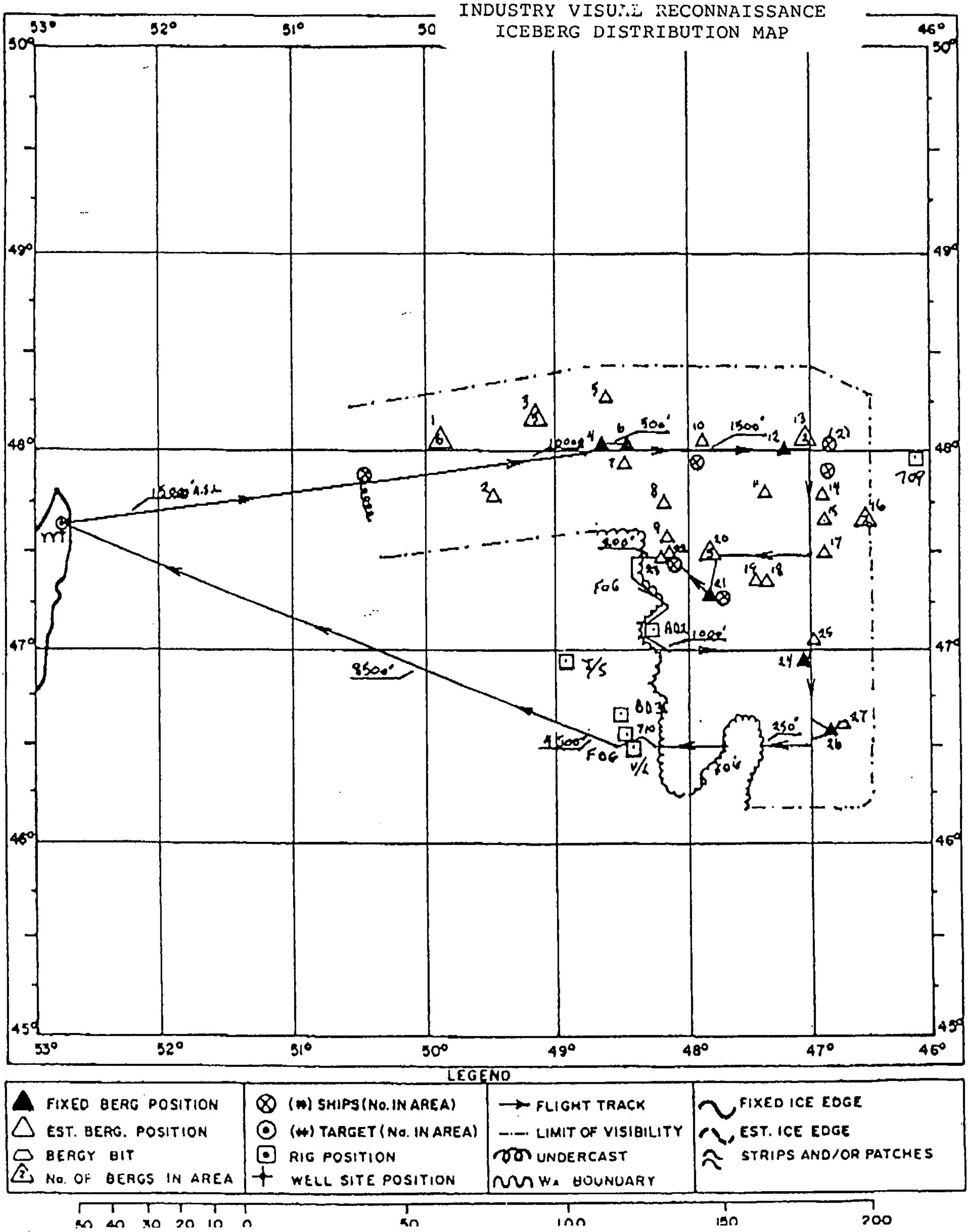


Figure A-7. Industry Visual Reconnaissance Iceberg Distribution Map

AIRCRAFT: B 200	REGISTRATION: CGPCD	DATE: 31 JAN 85
PILOT: A. FAULKNER	CO-PILOT: G. DAVIS	REPORT: # 0022
OBSERVER: T. BENSON	OTHER: NIL	REF:
DEPARTURE: YYT @ 1137 Z	ARRIVAL YYT @ 1534 Z	TOTAL HRS: 4.0

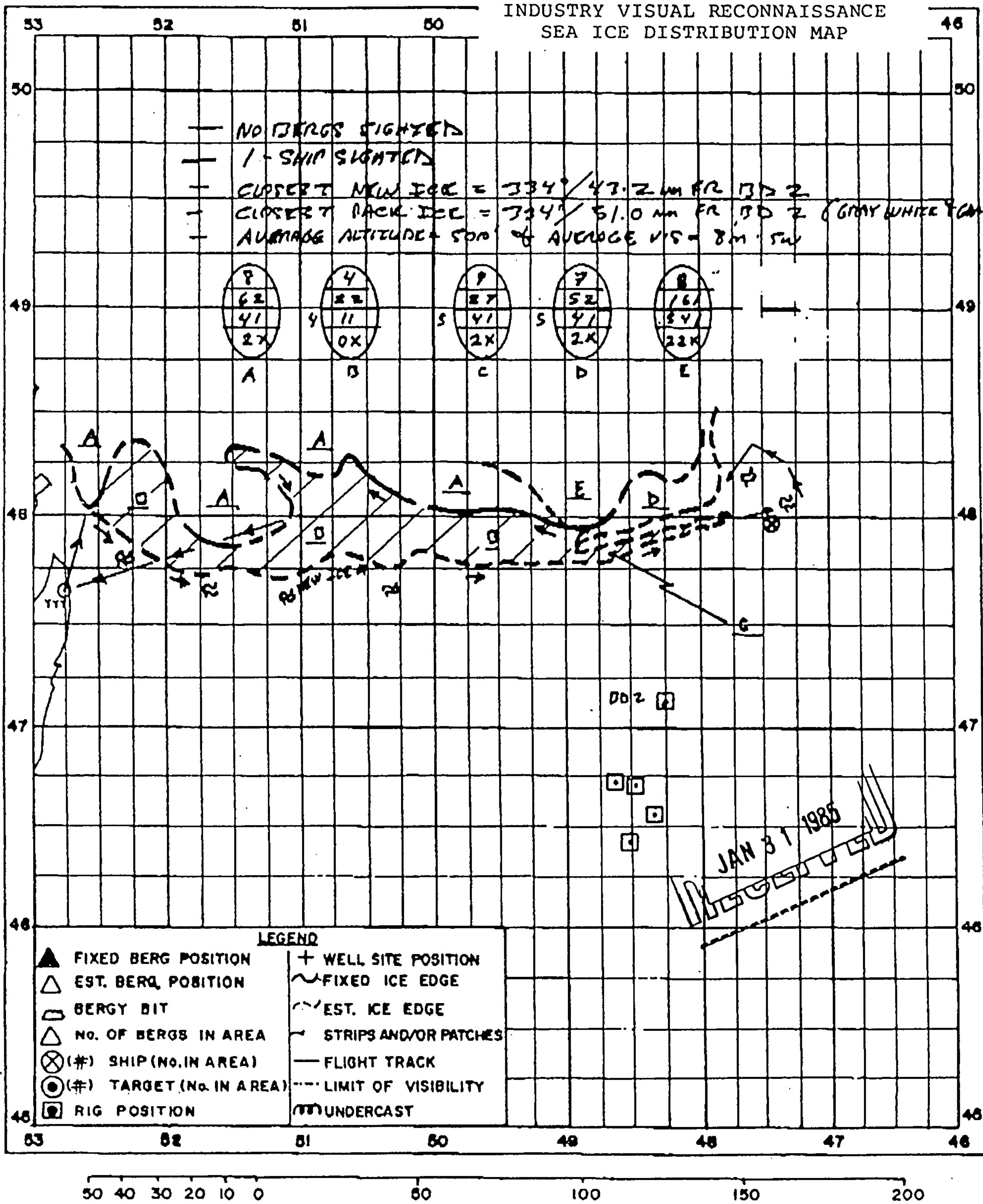


Figure A-8. Industry Visual Reconnaissance Sea Ice Distribution Map

FLIGHT INFORMATION MAP

SLAR AIRCRAFT FLIGHT ROUTE C-FMAR

ROUTE INFORMATION FOR FLIGHT NO. 72

WAY PTS.	LATITUDE	LONGITUDE
FROM	ST. JOHN'S	
TO 1.	N4940	W5057
2.	N4625	W4815
3.	LINE 2	21.5
4.	N.M	EAST OF
5.	LINE 1	
6.		
7.		
8.		

LENGTH APPROXIMATELY 430 MILES

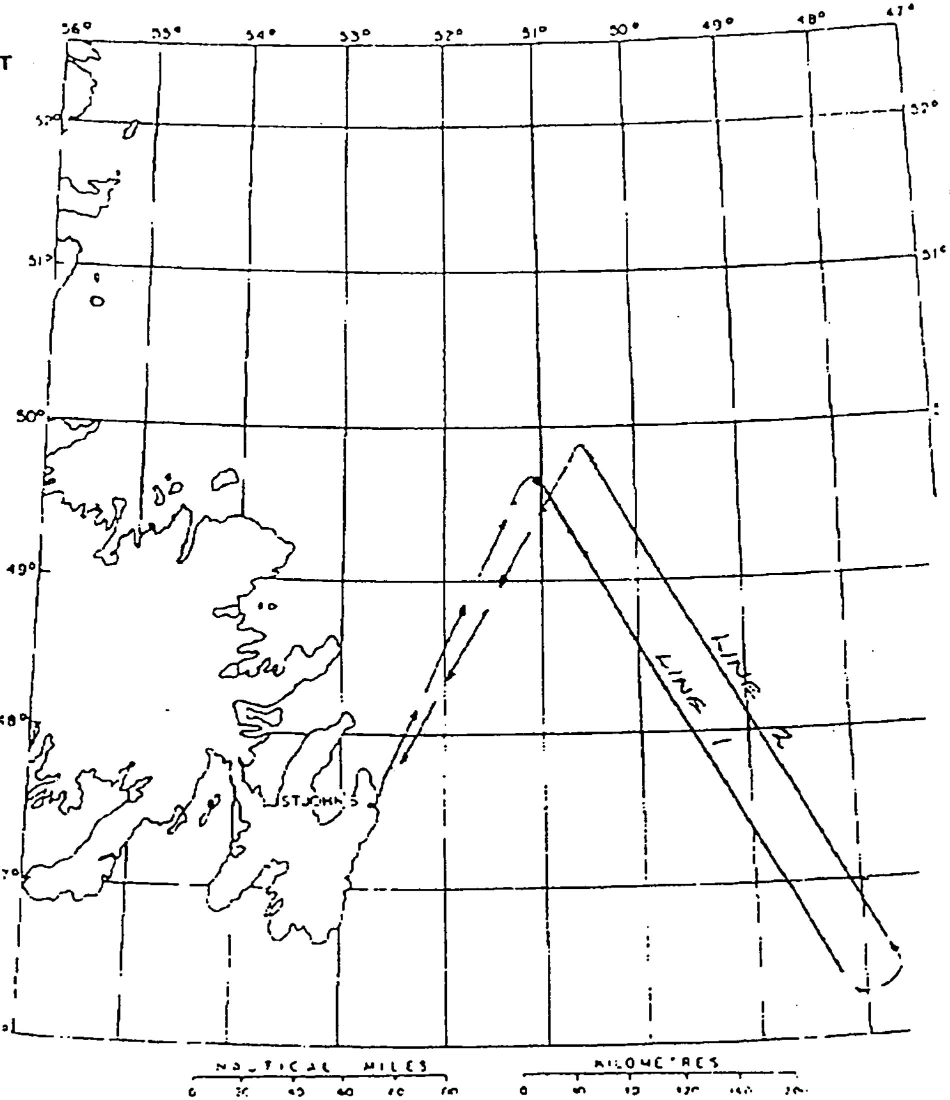
SCALE 1:500,000

DELAY 10

FLIGHT PLANNED FOR:

DATE 21 JUNE DEPARTURE TIME 1655 Z

ALTITUDE 17,000



TIMES

FLIGHT NO.	FLIGHT TIME	START	[illegible]
		STOP	[illegible]
	AIR TIME	OFF	[illegible]
		ON	[illegible]

APPROVED BY: [illegible]

CHARGED TO: G.S.[illegible]

FLIGHT NO.	FLIGHT TIME	START	
		STOP	
	AIR TIME	OFF	
		ON	

APPROVED BY:

CHARGED TO:

MARS 4b

Figure A-9. Industry SLAR Flight Information Map

MARS Ltd.
Flight Information Summary
Flight Number 73 21 Jun 1985

LINE #	TYPE	TARGET NUMBER	TIME	LATITUDE	LONGITUDE
51	SHIP	33	18:36	46.54.5	48.53.0
52	SHIP	52	18:37	46.54.8	48.54.3
53	SHIP	32	18:38	47.01.7	48.57.5
54	SHIP	31	18:38	47.02.1	48.57.1
55	SHIP	30	18:40	47.07.9	49.00.6
56	SHIP	29	18:40	47.09.3	49.01.5
57	SHIP	27	18:44	47.21.4	49.17.1
58	SHIP	28	18:44	47.23.7	49.15.5
59	UNCONFIRMED ICE BERG	59	18:33	47.14.8	47.32.6
60	DRILL RIG	34	18:37	46.55.1	48.54.0
61	SHIP	61	18:51	47.57.0	49.29.1
62	UNCONFIRMED ICE BERG	62	18:55	48.14.1	49.38.1
63	UNCONFIRMED ICE BERG	63	18:56	48.14.7	49.51.7
64	UNCONFIRMED ICE BERG	64	19:01	48.32.4	50.06.9
65	ICE BERG	14	18:59	48.32.4	49.41.6
66	ICE BERG	66	18:56	48.32.5	49.14.5
67	ICE BERG	67	18:56	48.34.3	49.07.5
68	ICE BERG	13	18:59	48.44.2	49.24.7
69	ICE BERG	12	19:01	48.52.6	49.29.7
70	ICE BERG	11	19:01	48.53.5	49.27.4
71	ICE BERG	10	19:02	48.56.8	49.30.0
72	UNCONFIRMED ICE BERG	72	19:03	49.01.6	49.31.2
73	UNCONFIRMED ICE BERG	73	19:02	48.55.8	49.23.8
74	UNCONFIRMED BERGY BIT	74	19:03	49.00.1	49.25.8
75	UNCONFIRMED BERGY BIT	75	19:02	49.00.5	49.21.3
76	UNCONFIRMED ICE BERG	76	19:00	48.54.3	49.08.5
77	UNCONFIRMED ICE BERG	77	19:00	48.56.8	49.06.1
78	UNCONFIRMED ICE BERG	78	18:56	48.42.1	48.44.1
79	UNCONFIRMED ICE BERG	79	18:54	48.33.0	48.35.6
80	UNCONFIRMED ICE BERG	80	18:52	48.22.6	48.34.0
81	UNCONFIRMED SHIP	81	18:51	48.21.4	48.30.6
82	UNCONFIRMED SHIP	82	18:52	48.24.4	48.38.6
83	SHIP	8	19:09	49.18.8	49.56.7
84	UNCONFIRMED SHIP	84	19:12	49.32.5	50.00.0
85	UNCONFIRMED ICE BERG	85	19:14	49.41.7	50.04.5
86	ICE BERG	3	19:14	49.25.3	50.32.8
87	ICE BERG	2	19:14	49.26.9	50.35.5
88	UNCONFIRMED ICE BERG	88	19:16	49.26.2	50.57.9

No egg codes generated on this flight.

Figure A-10. Industry SLAR Iceberg Summary

MacLaren Plansearch

Gridded Winds

ENTERED FEB 01 1985

JAN 31 1985

ANALYSIS: 8501312300 GMT

318/30	313/31	309/33	305/34	301/35	294/36	284/36
317/27	312/28	308/28	301/30	294/31	286/33	280/34
313/26	309/26	301/26	295/27	288/28	282/29	276/30
309/23	303/24	295/24	288/26	282/26	280/26	271/28

FORECAST: 8501312300 Z + 12

314/21	310/20	307/21	302/20	299/21	298/21	288/21
304/22	293/25	297/21	293/21	291/21	287/22	278/22
300/23	299/23	302/25	290/22	288/21	279/21	276/22
297/22	295/23	290/23	289/22	283/21	279/21	270/20

FORECAST: 8501312300 Z + 24

296/18	296/18	297/18	295/17	296/17	297/18	285/18
296/21	292/20	292/20	291/20	287/20	281/18	274/18
291/23	288/23	288/22	284/22	284/21	283/20	278/18
285/24	286/26	284/25	288/23	285/22	285/22	278/21

FORECAST: 8501312300 Z + 36

268/11	270/13	272/14	274/15	280/17	280/18	284/19
262/11	264/12	265/14	272/15	274/17	276/18	279/20
247/08	246/10	260/12	267/14	270/15	273/17	274/18
137/10	155/08	225/08	250/10	262/11	269/13	271/15

FORECAST: 8501312300 Z + 48

166/14	171/14	174/14	181/13	186/13	198/12	203/11
165/16	167/16	171/15	177/14	181/14	185/12	193/11
163/18	167/18	169/17	173/16	177/14	181/12	186/11
163/20	168/19	171/18	171/17	175/15	178/13	182/11

Figure A-11. Gridded Wind Input Data Product

VESSEL ROUTING REPORT

DATE (GMT):23 Jul 1985 TIME (GMT): 1330 Page:1

To: Shore base
By: Telecopier, Telex, Voice

CC. Ice coordinator
Ice information center

OBSERVER: R.B.MILES RIG: VINLAND WELL: NORTH TRINITY H-71

Name of ice surveillance vessel: OFFSHORE HUNTER
Call sign of ice surveillance vessel: 2329
Time/date vessel dispatched: 1330 23 Jul 85
Location vessel dispatched from: N.TRINITY H-71
Reporting interval: 3
Patrol Check Points
1. 46 41.0 N 47 48.0 W 2. 46 20.0 N 47 51.0 W
3. 46 20.0 N 49 0.0 W
Estimated total patrol duration : 15

COMMENTS:
REPORT EVERY 3hr. REPORT ANY ICE UPON SIGHTING TO VINLAND. RETURN TO VINLAND AFTER CHECK POINT 3

Approved by ______________________ Name ______________________
Operators Senior Representative

RECEIVED JUL 23 1985

ENTERED JUL 23 1985

Figure A-12. Industry Vessel Routing Report

HUSKY BOW VALLEY OPERATIONS
SUITE 810, ATLANTIC PLACE
TELEX 016-3259
ST. JOHN'S

MSG NO: 012
DATE: 85.01.31
TIME: 20:00 NST

TO: FLIGHT FOLLOWING - HBV PIER 27 - DOBROCKY ICE CENTER

CC: FRED LEAFLOOR - TOM MURPHY - TOM MURRAY

FROM: HBV RADIO ROOM SNF

RE: 20:00 NST VESSEL POSITION REPORTS

SEDCO 706 (WVFN) UNDER TOW
ACCOMPANYING VESSELS - BONAVISTA BAY + ARCTIC SHIKO
NOW REPORTING TO HALIFAX SHOREBASE

BOW DRILL 2 (VCNP)
CONQUEST K-09 (47 08 34.4N 48 15.44W)

BOW DRILL 3 (VSBC4)
N. BEN NEVIS P-93 (46 42.5N 48 28.3W)

CHIGNECTO BAY (VXJK)
STBY BD2

MAHONE BAY (VXGB)
UNDER HFX CONTROL

TRINITY BAY (VXJF)
STBY PIER 27 SNF

PLACENTIA BAY (VCYQ)
STBY BOW DRILL 3

GABARUS BAY (VCYS)
STBY BOW DRILL 2

OFFSHORE TRADER (VO4296)
STBY PIER 27 SNF

Figure A-13. Vessel and Rig Status Report

MESSAGE CODE:
FICN2
97

FICN2 CWIS 121330
ICE CONDITIONS AND FORECAST FOR THE EAST COAST OF NEWFOUNDLAND
AND LABRADOR ISSUED AT 1330 GMT FRIDAY 12 JULY 1985 BY
ENVIRONMENT CANADA ICE CENTRE OTTAWA

ICE EDGE ESTIMATED FROM THE LABRADOR COAST NEAR 5430N 5715W TO
5340N 5520W TO 5405N 5245W TO 5440N 5220W TO 5530N 5540W TO
5710N 5830W TO 5840N 5900W TO 6100N 6400W TO 6215N 6400W TO
6250N 6230W TO 6310N 6240W THEN NORTHNORTHEASTWARD.
IN ADDITION, 2 PATCHES OF THICK ICE ARE STILL EXPECTED OFF FOGO
ISLAND; ONE AT 20 MILES NORTHNORTHEAST OF FOGO, AND THE OTHER AT
25 MILES EASTNORTHEAST OF FOGO.

STRAIT OF BELLE ISLE AND APROACHES...
NUMEROUS ICEBERGS.

SOUTH LABRADOR COAST...
BERGY WATERS SOUTH OF SPOTTED ISLAND. OPEN TO CLOSE DRIFT THICK
FIRST YEAR AND OLD ICE IN THE ENTRANCES TO GROSWATER BAY. FURTHER
EAST OF GROSWATER, THERE IS VERY OPEN DRIFT INSIDE THE EDGE.

FORECAST VALID UNTIL 0400 GMT 14 JULY AND OUTLOOK FOR SUNDAY...
LIGHT TO MODERATE EASTWARD DRIFT AND WARM TEMPERATURES LEADING
TO THE FINAL MELT OF THE ICE OFF FOGO ISLAND.

NOTE TO ALL...THIS WILL BE THE LAST FICN2 FOR THE WINTER 1984/1
THE FICN6 WILL BE ISSUED DAILY AND WILL COVER HUDSON BAY AND ITS
APPROACHES INCLUDING THE LABRADOR COAST

END

Figure A-14. AES Ice Conditions and Outlook

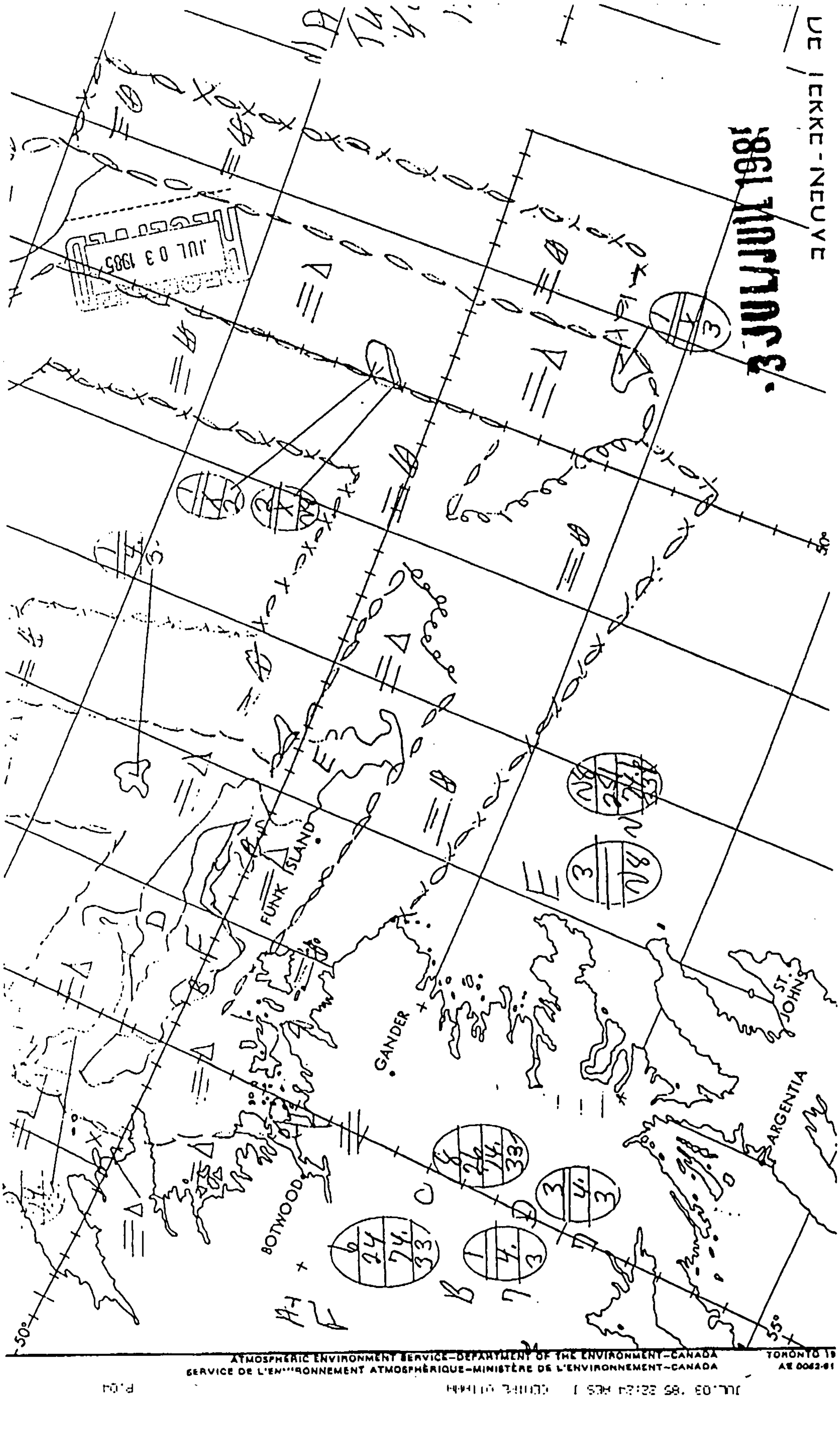


Figure A-15. AES Observed Chart

```
BBACKZ ICE SNF
IOE RESICE OTT JULY 2  542

IACN1 CYQX 020340
FNAY 11662 01675
00000
CYFB 21230 1X060 2XXXX 3XXXX 4XXXX 76345 06930
21231 11060 21515 30000 4XXXX 76310 06830
21240 1X060 2XXXX 3XXXX 4XXXX 76215 06823
21250 17060 21515 33035 4XXXX 76120 06926
21305 15060 22020 33035 4XXXX 76043 06330
21313 16069 22020 33535 4XXXX 76000 06930
21323 16060 22020 34040 4XXXX 75945 06743
21335 16060 22010 34040 4XXXX 75931 06705
21341 16060 22020 34040 4XXXX 75930 06700
21342 16060 22020 34040 4XXXX 76021 06544
21359 16060 21500 34040 4XXXX 76038 06528
21402 16060 21500 33540 4XXXX 76109 06426
21415 11060 21515 33540 4XXXX 76200 06300
21432 10060 21515 33540 4XXXX 76035 06100
21457 12060 20202 33540 4XXXX 75935 06032
21522 10060 21515 33540 4XXXX 75910 06010
21523 10060 21515 33030 4XXXX 75320 05930
21542 10060 20000 33535 4XXXX 75726 05343
21556 10060 20510 33535 4XXXX 75713 05340
21559 1X060 20000 33535 4XXXX 75700 05330
21602 15060 20000 33535 4XXXX 75653 05317
21606 10060 21015 33535 4XXXX 75645 05751
21611 17060 20000 33535 4XXXX 75400 05200
21716 17060 20000 33535 4XXXX 75215 05255
21745 10060 21500 33535 4XXXX 75200 05300
21749 10060 21515 34545 4XXXX 75201 05230
21754 10060 20000 34745 4XXXX 75200 04930
21832 17060 20000 34545 4XXXX 74900 04990
21903 17060 20000 34545 4XXXX 74359 05040
21926 10060 20000 3XXXX 4XXXX 74346 05123
21935 10060 21010 3XXXX 4XXXX 74346 05221
21945 10060 21516 3XXXX 4XXXX 74345 05230
21947 10060 21515 3XXXX 4XXXX 74325 05230
21957 10060 21500 3XXXX 4XXXX 74340 05230
22001 17060 21515 3XXXX 4XXXX 75000 05330
22007 17060 21516 SXXXX 4XXXX 75000 05335
22020 15060 21515 34040 4XXXX 75000 05500
22035 14060 21515 34040 4XXXX 74919 05442
22045 1X035 2XXXX 3XXXX 4XXXX CYQX
22055
22222
31256 62150 63540 02102 0217X
31255 62170 63530 04102 0413X
31255 62130 63470 02102 0214X
31257 62100 63100 02101 02141
31253 62070 63070 04102 0414X
31419 61260 64300 02102 02239
31421 61300 64290 10105 10259
31420 61220 63330 19111 1973X
31422 61250 63270 03110 0374X
31422 61250 63270 10110 1075X
31423 61270 63240 10119 1072X
```

Total 685

RECEIVED JUL 02 1985

Figure A-16. AES Iceberg Report

DBRCKY ICE SNF

CNCP SAFT
GOB579 JUL 17 1538 EST

CCGTC SNF
001 011
RX 0164179 DBRCKY ICE SNF

OB ICE ST. JOHN'S, NEWFOUNDLAND DH JULY 172009Z

TO: ICE CENTRAL OTTAWA
COMINTICEPAT GROTON CT
DMA HTC WASHINGTON
MOBIL OIL
HUSKY BOW VALLEY
PETRO CANADA
COGLA
CANTERRA
DOBROCKY SEA TECH
ESSO RADIO SNF

RECEIVED JUL 17 1985

No Visual Confirmation!!

FOR YOUR INFO.

M/V 'VANZ' ''RADAR TARGETS OBSEVED IN THICK FOG AT 170100Z 49.13N 44.28W AT 171230Z AT 48.15N 46.20W AND 48.30N 46.34W AT 171747Z AT 48.64N 47.48W AND 48.06N 47.50W''

ESSICAMILLAZ9UKL SPOTTED TOW UNIDENTIFIED RADAR TARGETS IN POSITION 48.36N 44.30W AND 48.15N 46.14W.

ICE ST. JOHN'S
RS/JLB
TAPED: 172021Z

Figure A-17. Typical CCG Ship Report on Icebergs

APPENDIX B

USER PRODUCT MATRIX QUESTIONNAIRE

REVIEW OF DATA PRODUCTS

The purpose of this review is to solicit reviews and comments on the numerous data prdocuts which are produced by the Ice Data Management System (IDMS). We wish to know which of the products listed below you use for your specific job, how you use them, how you get them, relative importance of each one as well as any comments on their format and presentation. The aim is to create a matrix of responses to see which products are most useful and which ones are not. We will show you examples of these products and ask some specific questions about each of them as follows:

1. Do you receive the product?

2. How do you receive it - by the remote workstation, photocopy, other means?

3. Do you use the product in your job or is it for information only? How do you use it?

4. Are you satisfied with the product for its accuracy and presentation format? Do you have any suggestions on how to improve the product?

5. When do you need the product for your job? It is delivered in a timely fashion. If not, what would you require?

6. Is the frequency of updates to these products sufficient to meet your needs? What are your requirements in terms of updates?

7. Please rate the product in its importance to your job function 1 - not important; 5 - critical).

8. General comments on the product and the range of features which can be incorporated into them. Are there other features you would like to have?

9. What are your views on forecasting ice and iceberg movements? What confidence do you place in the forecasts of weather and ice? Do the models now in use at IDMS provide good, bad or reasonable projections during 1985?

10. Do you have any requirement for archiving any or all of these products? Are the products you now receive kept on file after use or discarded? Would you see an IDMS being responsible for archiving?

The following tables list all the output products available from IDMS through the remote workstations. Please indicate which products you personally receive and use which we will focus on in the interview.

IDMS PRODUCT USAGE AND USEFULNESS

GROUP 1 ESTIMATED CONDITIONS AT REPORT VALID TIME (ISSUED AT 0730 LCL TIME)

		Receive Product (Yes/No)	How do you receive it (Work station, copy)	Use Product (Yes/No)	Quality of Product (Accuracy, Pres'n)	Timeliness-Req'd -Actual	Frequency of updates Req'd, Actual	Importance to your job function scale (1-5) 1-not imp. 5-critical	How is the product used in your function	General comments on product	Suggested Improvements
1-0	Ice Status Report Synopsis										
1-1	Estimated Iceberg Concentrations										
1-2	Newfoundland Waters Regional Ice Map										
1-3	Grand Banks Area Ice Map										
1-4	Drilling Area Ice Map										
1-5-0	Rig Site Map - Complete										
1-5-1	Rig Site Map - NW Quadrant										
1-5-2	Rig Site Map - SW Quadrant										
1-5-3	Rig Site Map - SE Quadrant										
1-5-4	Rig Site Map - NE Quadrant										
1-6	Areas Searched Map										

GROUP 2 FORECAST STATUS FOR THE NEXT 48 HOURS

		Receive Product (Yes/No)	How do you receive it (work station, copy)	Use Product (Yes/No)	Quality of Product (Accuracy, Pres'n)	Timeliness-Req'd -Actual	Frequency of updates Req'd, Actual	Importance to your job function scale (1-5) 1-not imp. 5-critical	How is the product used in your function	General comments on product	Suggested Improvements
2-1	Grand Banks Area Ice Map - Forecast Version										
2-2	Drilling Area Map - Forecast										
2-3-0	Rig Site Ice Map - Complete Forecast										
2-3-1	Rig Site Map - NW Quadrant Forecast										
2-3-2	Rig Site Map - SW Quadrant Forecast										
2-3-3	Rig Site Map - SE Quadrant Forecast										
2-3-4	Rig Site Map - NE Quadrant Forecast										

GROUP 3 PRINTED ICE INFORMATION

		Receive Product (Yes/No)	How do you receive it (Work station, copy)	Use Product (Yes/No)	Quality of Product (Accuracy, Pres'n)	Timeliness-Req'd -Actual	Frequency of updates Req'd, Actual	Importance to your job function scale (1-5) 1-not imp. 5-critical	How is the product used in your function	General comments on product	Suggested Improvements
3-1	Last Observed Iceberg Data										
3-2	Forecast Iceberg Positions - Latitude/Longitude										
3-3	Forecast Iceberg Positions - Range/Bearing from Rigs/Wellsite										
3-4	Forecast Closest Sea Ice - Range/ Bearing from Rigs/Wellsite										
3-5	Summary of Assigned Iceberg Numbers										

GROUP 4 PRINTED SYSTEM SUMMARY INFORMATION

	Receive Product (Yes/No)	How do you receive it (Work station, copy)	Use Product (Yes/No)	Quality of Product (Accuracy, Pres'n)	Timeliness-Req'd -Actual	Frequency of updates Req'd, Actual	Importance to your job function scale (1-5) 1-not imp. 5-critical	How is the product used in your function	General comments on product	Suggested Improvements
4-1 Vessel Status										
4-2 Vessel Usage Summary										
4-3 System Usage Summary										
4-4 Report Data Sources										

GROUP 5 LAST OBSERVED STATUS

		Receive Product (Yes/No)	How do you receive it (Work station, copy)	Use Product (Yes/No)	Quality of Product (Accuracy, Pres'n)	Timeliness-Req'd -Actual	Frequency of updates Req'd, Actual	Importance to your job function scale (1-5) 1-not imp. 5-critical	How is the product used in your function	General comments on product	Suggested Improvements
5-1	Last Observed Iceberg Concentrations										
5-2	Newfoundland Waters Regional Ice Map - Last Observed										
5-3	Grand Banks Area Ice Map - Last Observed										
5-4	Drilling Area Ice Map - Last Observed										
5-5-0	Rig Site Map - Complete - Last Observed										
5-5-1	Rig Site Map - NW Quadrant - Last Observed										
5-5-2	Rig Site Map - SW Quadrant - Last Observed										
5-5-3	Rig Site Map - SE Quadrant - Last Observed										
5-5-4	Rig Site Map - NE Quadrant - Last Observed										

GROUP 6 SLAR DATA PRODUCTS

		Receive Product (Yes/No)	How do you receive it (Work station, copy)	Use Product (Yes/No)	Quality of Product (Accuracy, Pres'n)	Timeliness-Req'd -Actual	Frequency of updates Req'd, Actual	Importance to your job function scale (1-5) 1-not imp. 5-critical	How is the product used in your function	General comments on product	Suggested Improvements
6-1	Iceberg Concentrations										
6-2	Newfoundland Waters Map										
6-3	Grand Banks Area Ice Map										
6-4	Drilling Area Ice Map										
6-5-0	Rig Site Map - Complete										
6-5-1	Rig Site Map - NW Quadrant										
6-5-2	Rig Site Map - SW Quadrant										
6-5-3	Rig Site Map - SE Quadrant										
6-5-4	Rig Site Map - NE Quadrant										
6-6	Areas Searched Map										
6-7	Printed SLAR Targets										
6-8	SLAR Flight Information										

APPENDIX C

COMMUNICATIONS INTERVIEW GUIDELINES

GRAND BANKS ICE DATA MANAGEMENT SYSTEM STUDY

COMMUNICATIONS INTERVIEW GUIDELINES

1. PREAMBLE

The purpose of these interview guidelines is to define the information required from each group of interviewees. It is not intended as a questionnaire, but as both an indication to potential interviewees as to the subject matter of the interviews, and as an aide memoire to the interviewer.

As the information required is not necessarily the same for each group of interviewees, the guidelines are given under interviewee group heading. In some cases information is required only in reference to the performance of GB-IDMS/85 and in some cases in relation to future needs of GB-IDMS. Thus the questions are tabulated under these two headings.

In most cases all information would be gained at one interview, with information on the performance of GB-IDMS/85 being obtained first to prevent biased opinions due to emphasis on future needs rather than past performance. It is expected that in a few cases a second interview (during the same visit to St. John's by the interviewer) might be required to clarify matters arising during preliminary analysis, or from another interview.

2. GUIDELINE FOR INTERVIEWS TO VARIOUS GROUPS OF IDMS PARTICIPANTS

2.1 Management Committee Representative

1985 GB-IDMS	FUTURE GB-IDMS
. Have communications problems limited GB-IDMS/85 in any way? If so, how?	. What communications changes do you think would improve IDMS effectiveness?
	. Do you think a common IDMS satellite data link would improve overall effectiveness if it were cost-effective?
	. What changes in communications routing, if any, are required?

2.2 Management Representative

1985 GB-IDMS

- Have communications problems reduced or limited GB/IDMS/85 effectiveness in any way? If so, how?

FUTURE GB-IDMS

- What are future ice communications needs? How receptive would company (and you) be to a common satellite IDMS data channel with direct rig input, capable of carrying additional data traffic from all sources and of being company encoded with complete national flexibility of geographic IP/OP location?

- What changes in communications routing (if any) are required?

2.3 Ice Coordinator

1985 GB-IDMS

- Have communications problems required or limited GB-IDMS/85 operations in any way? If so, how?

FUTURE GB-IDMS

- What are future communications needs? How receptive would company (and you) be to a common satellite IDMS data channel with direct rig input, company coded if required, with complete national flexibility of geographic IP/OP required?

2.4 Onshore Radio Operator

1985 GB-IDMS

- Discuss current communications set-up; schedules; frequencies and modes; congestion and reliability problems. General comments on communications. Company communications rules and constraints

FUTURE GB-IDMS

- Ideas for communications improvement.

- Is a dedicated ice-data channel (HF or satellite) feasible?

2.4 Onshore Radio Operator (Cont'd)

1985 GB-IDMS

- Is a common frequency(ies) used for all ice transmissions?
- If not, could one be made available?
- What are current INMARSAT satellite links? How useful and effective are they?

FUTURE GB-IDMS

- Is a dedicated ice-date channel (HF or satellite) feasible?
- What changes in communications routing (if any) are required?

2.5 Rig Captain

1985 GB-IDMS

- Any communications problems? Comments?

FUTURE GB-IDMS

- Any specific communications needs?

2.6 Rig Ice Observer

1985 GB-IDMS

- Discuss current communications set-up; schedules; frequencies and modes used; conjestion and reliability problems. General comments on communications.
- What satellite communications do you have? How good are they?

FUTURE GB-IDMS

- Ideas for future communications improvement.

2.7 Rig Radio Operator

1985 GB-IDMS

- Discuss current communications set-up; schedules; frequencies and modes used; conjestion and reliability problems - no real problem except occasional poor operating procedure. General comments on communications.

FUTURE GB-IDMS

- Ideas for future communications improvement.

2.7 Rig Radio Operator (Cont'd)

1985 GB-IDMS	FUTURE GB-IDMS
. What satellite communications do you have? How good are they?	

2.8 Drilling Engineer

1985 GB-IDMS	FUTURE GB-IDMS
. General review of communications approach costing, problems, effectiveness, alternate approaches considered frequencies available. Equipment currently in use, reliability, costs, company policies and constraints.	. Opinions on common use, coded, satellite data link.
. What is current arrangement with Inmarsat? How useful is it? What are costs? What problems are there, on land, on rigs?	
. Is HF digital currently used?	

2.9 Senior Representative on Rig

1985 GB-IDMS	FUTURE GB-IDMS
. General impression of communications efficiency.	. Perceived future communications needs.

2.10 Vessel Captain and/or Watchkeeping Officer

1985 GB-IDMS	FUTURE GB-IDMS
. Message transmission times, transmission mode and frequency typical length.	. As current.

2.11 COGLA - Ottawa

1985 GB-IDMS	FUTURE GB-IDMS
. General impression of communications efficiency.	. Perceived future communications needs.

2.12 Plansearch Weather Service for IDMS

1985 GB-IDMS	FUTURE GB-IDMS
. Message transmission times - every six hours - related to local time change with summer time. Telco dial up telex to Husky.	. As current
. Transmission mode and frequency - N.A.	
. Typical length approximately 5 minutes at standard telex, if wind only could be used, a minute or so.	

2.13 Newfoundland Petroleum Directorate

1985 GB-IDMS	FUTURE GB-IDMS
. General impression of communications efficiency.	. Perceived future communications needs.

2.14 Ice Centre AES - Forecasting

1985 GB-IDMS	FUTURE GB-IDMS
. General impression of communications efficiency.	. Future Ice Centre communications methods and compatibility
. Current Ice Centre communications methods and IDMS compatibility.	

2.15 Newfoundland Telephone

1985 GB-IDMS	FUTURE GB-IDMS
. Conditioned and unconditioned land-line tariffs.	. Any planned changes in policies or tariffs
. Discussion on general availability of land-lines in St. John's	
. Connection/disconnection costs	
. Modem lease/buy costs	
. Interconnect policy	
. Inmarsat tariffs	
. Inmarsat interconnect costs and policies	
. Telesat interconnect costs and policies	
. What was land-line problem with GB-IDMS in Feb. 1985? How was it solved?	
. Are current circuits switched dedicated, or both?	

2.16 Telesat Canada

1985 GB-IDMS	FUTURE GB-IDMS
	. Confirm Anik D coverage of Grand Banks
	. Confirm SCPC tariffs
	. Confirm availability of experimental program Anik D space
	. Obtain earth station lease costs including semi-stabilized rig earth stations.

APPENDIX D

LIST OF INTERVIEWEES FOR IDMS USER SURVEY AND EVALUATION

ICE DATA MANAGEMENT SYSTEM STUDY

USER SURVEY

LIST OF INTERVIEWEES

1. Mr. Brian Fox
   Environmental Analyst
   MARS Ltd.
   13 Old Petty Harbour Road
   St. John's, Newfoundland
   Phone: (709) 364-9155

2. Mr. Duncan Finlayson
   Weather Forecaster
   NORDCO Ltd.
   P.O. Box 8833
   St. John's, Newfoundland
   Phone: (709) 364-1200

3. Mr. Brian Miles
   Rig Ice Observer
   NORDCO Ltd.
   P.O. Box 8833
   St. John's, Newfoundland
   Phone: (709) 364-1200

4. Mr. Glen Snow
   Visual Aircraft Ice Observer and Rig Ice Observer
   FENCO (Nfld) Ltd.
   P.O. Box 8246
   St. John's, Newfoundland, AlB 3N4
   Phone: (709) 754-1480

5. Mr. Owen Myers
   Rig Ice Observer
   FENCO (Nfld) Ltd.
   P.O. Box 8246
   St. John's, Newfoundland, AlB 3N4
   Phone: (709) 754-1480

6. Mr. Garland Ellsworth
   Rig Ice Observer
   FENCO (Nfld) Ltd.
   P.O. Box 8246
   St. John's, Newfoundland, AiB 3N4
   Phone: (709) 754-1480

LIST OF INTERVIEWEES (Cont'd)

7. Mr. N.A. Helle
Communications Supervisor
Atlantic Exploration Services
65A LeMarchant Road
St. John's, Newfoundland, A1C 2G9
Phone: (709) 753-7697

8. Mr. Art Davis
Shore Base Radio Operator
Atlantic Exploration Services
65A LeMarchant Road
St. John's, Newfoundland, A1C 2G9
Phone: (709) 753-7697

9. Mr. G. Watson
Rig Radio Operator
Atlantic Exploration Services
65A LeMarchant Road
St. John's, Newfoundland, A1C 2G9
Phone: (709) 753-7697

10. Captain Marvin Parry
Vessel Captain
Husky Marine
Box 37, 215 Water Street
Suite 707, Atlantic Place,
St. John's, Newfoundland, A1C 6C9
Phone: (709) 722-8050

11. Mr. Perry White
Rig Ice Observer
FENCO (Nfld) Ltd.
P.O. Box 8246
St. John's, Newfoundland, A1B 3N4
Phone: (709) 754-1480

12. Mr. David Layte
Rig Ice Observer
FENCO (Nfld) Ltd.
P.O. Box 8246
St. John's, Newfoundland, A1B 3N4
Phone: (709) 754-1480

13. Captain Keith Ballantyne
Rig Captain
Bow Valley Offshore
Bally Rou Place
280 Torbay Road, Box 5487
St. John's, Newfoundland, A1C 5W4
Phone: (709) 772-2078

LIST OF INTERVIEWEES (Cont'd)

14. Mr. Ron Flynn
Shore Base Radio Operator
Mobil Oil Canada Ltd.
Box 62, Atlantic Place
215 Water Street
St. John's, Newfoundland, A1C 6C9
Phone: (709) 778-7000

15. Mr. Dave Betts
Environmental Coordinator
Petro-Canada Resources
P.O. Box 5190
St. John's, Newfoundland, A1C 6H2
Phone: (709) 753-6526

16. Ms Kathy Satterfield
Environmental Analyst
Petro-Canada Resources
P.O. Box 2844
Calgary, Alberta, T2P 3E3
Phone: (403) 296-6319

17. Mr. D. Rowe
Shore Base Radio Operator
Petro-Canada Resources
P.O. Box 5190
St. John's, Newfoundland, A1C 6H2
Phone: (709) 753-6526

18. Mr. Jim Ransom
Environmental Coordinator
Mobil Oil Canada Ltd.
Box 62, Atlantic Place
215 Water Street
St. John's, Newfoundland, A1C 6C9
Phone: (709) 778-7000

19. Mr. Mike Hassell
Environmental Planning
Mobil Oil Canada Ltd.
Box 62, Atlantic Place
215 Water Street
St. John's, Newfoundland, A1C 6C9
Phone: (709) 778-7000

20. Mr. Mike Everett
Drilling Supervisor
Husky/Bow Valley East Coast Project
Box 79, 215 Water Street
St. John's, Newfoundland, A1C 6C9
Phone: (709) 722-6209

LIST OF INTERVIEWEES (Cont'd)

21. Mr. Rick Preston
Environmental Advisor
ESSO Resources Canada Limited
P.O. Box 2217
St. John's, Newfoundland, A1C 6E6
Phone: (709) 579-5170

22. Mr. Greg Warbanski
Environmental Supervisor
Husky/Bow Valley East Coast Project
Box 79, 215 Water Street
St. John's, Newfoundland, A1C 6C9
Phone: (709) 722-6209

23. Mr. Tom Murphy
Environmental Department
Husky/Bow Valley East Coast Project
Box 79, 215 Water Street
St. John's, Newfoundland, A1C 6C9
Phone: (709) 722-6209

24. Mr. A. Rowsell
Ice Operations
Canadian Coast Guard
P.O. Box 1300
St. John's, Newfoundland, A1C 6H8
Phone: (709) 772-2078

25. Mr. D. Burley
Mr. J. Bugden
Newfoundland and Labrador Petroleum Directorate
P.O. Box 4750
St. John's, Newfoundland, A1C 5T7
Phone: (709) 576-2370

26. Mr. Ian Borthwick
COGLA
Suite 500, TD Place
140 Water Street
St. John's, Newfoundland, A1C 6H6
Phone: (709) 772-2125

27. Mr. Mert Hanni
Mr. Guy Howard
Offshore Drilling
Petro-Canada Resources
P.O. Box 5190
St. John's, Newfoundland, A1C 6H2
Phone: (709) 753-6526

LIST OF INTERVIEWEES (Cont'd)

28. Mr. O. Mycyk
COGLA
355 River Road
Tower B
Ottawa, Ontario, K1A 0S5
Phone: (613) 995-3065

29. Mr. Hugh McRuer
Ice Product Development
Atmospheric Environment Service
365 Laurier Avenue West
Ottawa, Ontario, K1A 0H3
Phone: (613) 996-5236

30. Mr. Brian Terry
Mr. Derek McDonald
Dobrocky Seatech Limited
P.O. Box 2278, Station C
St. John's, Newfoundland, A1C 6E6
Phone: (709) 364-2981

31 Mr. P. Debourke
Communications Project Manager
Grove Telecommunications Ltd.
P.O. Box 1910
152 Water Street
St. John's, Newfoundland, A1A 2X9
Phone: (709) 753-8587

32. Mr. J. Ward
Experimental Programs Manager
Telesat Canada
333 River Road
Ottawa, Ontario
Phone: (613) 746-5920

33. Mr. Bryan Peddie
Sales Manager
Polestar Communications Ltd.
P.O. Box 2280
Morinville, Alberta, T0G 1P0
Phone: (403) 939-8577

34. Captain O. Loken
Rig Captain
S.D.S. Drilling
Bally Rou Place
280 Torbay Road
St. John's, Newfoundland, A1A 3W8
Phone: (709) 579-0010

LIST OF INTERVIEWEES (Cont'd)

35. Captain B. Freehill
Rig Captain
SONAT Offshore Canada Ltd.
P.O. Box 548
Mount Pearl, Newfoundland, A1N 2W4
Phone: (709) 364-6818

36. Mr. R. Cave
Shore Base Radio Operator
ESSO Resources Canada Limited
P.O. Box 2217
St. John's, Newfoundland, A1C 6E6
Phone: (709) 579-5170

37. Mr. Paul Thomey
Communications Consultant
Newfoundland Telephone
Fort William Building
St. John's, Newfoundland
Phone: (709) 739-2500

38. Mr. Ole Moller
Engineering Manager
Husky/Bow Valley East Coast Project
Box 79, 215 Water Street
St. John's, Newfoundland, A1C 6C9
Phone: (709) 722-6209

39. Mr. Stan Johnston
Drilling Supervisor
Canterra Energy Limited
P.O. Box 5640
St. John's, Newfoundland, A1C 5W8
Phone: (709) 753-9555

40. Mr. John Miller
Environmental Specialist
Petro-Canada Resources
P.o. Box 2844
Calgary, Alberta, T2P 3E3
Phone: (403) 296-6308

41. Mr. L.G. Spedding
Environmental Coordinator
ESSO Resources Canada Limited
339-50th Avenue S.E.
Calgary, Alberta, T2G 2B3
Phone: (403) 259-0335

APPENDIX E

EXAMPLES FROM REDUCED LIST OF IDMS DATA PRODUCTS

ICE STATUS REPORT SYNOPSIS

VALID TIME: 85-05-25 07:30 NDT

REPORT #168 PRODUCT: 1-0

RECONNAISSANCE:
Ice reports from six industry vessels, three rigs and one helicopter flight.

WEATHER CONDITIONS:
GALE WARNING ENDING AT NOON.
GRAND BANKS: Winds E 30-40 kts. this morning, decreasing to light SE this afternoon. Max seas 10' today, 5' Sunday.

ICE CONDITIONS:

BOW DRILL 2 /CONQUEST K-09
Closest reported iceberg is #1080, forecasted to be presently 28 Nmi. NE of location.

JOHN SHAW /MERCURY K-76
Closest reported iceberg is #580, last reported grounded 45 Nmi. NW o location.

BOW DRILL 3 /NORTH BEN NEVIS P-93
Closest reported iceberg is #923, forecasted to presently lie 49 Nmi. SE of location.

DRILLING AREA, ST. JOHN'S AND APPPROACHES
DRILLING AREA: Main concentration of icebergs in Northern quadrants are expected to drift SW this morning and light variable drift this afternoon. 39 icebergs included in this report.
ST. JOHN'S AND APPROACHES: Bergy waters.

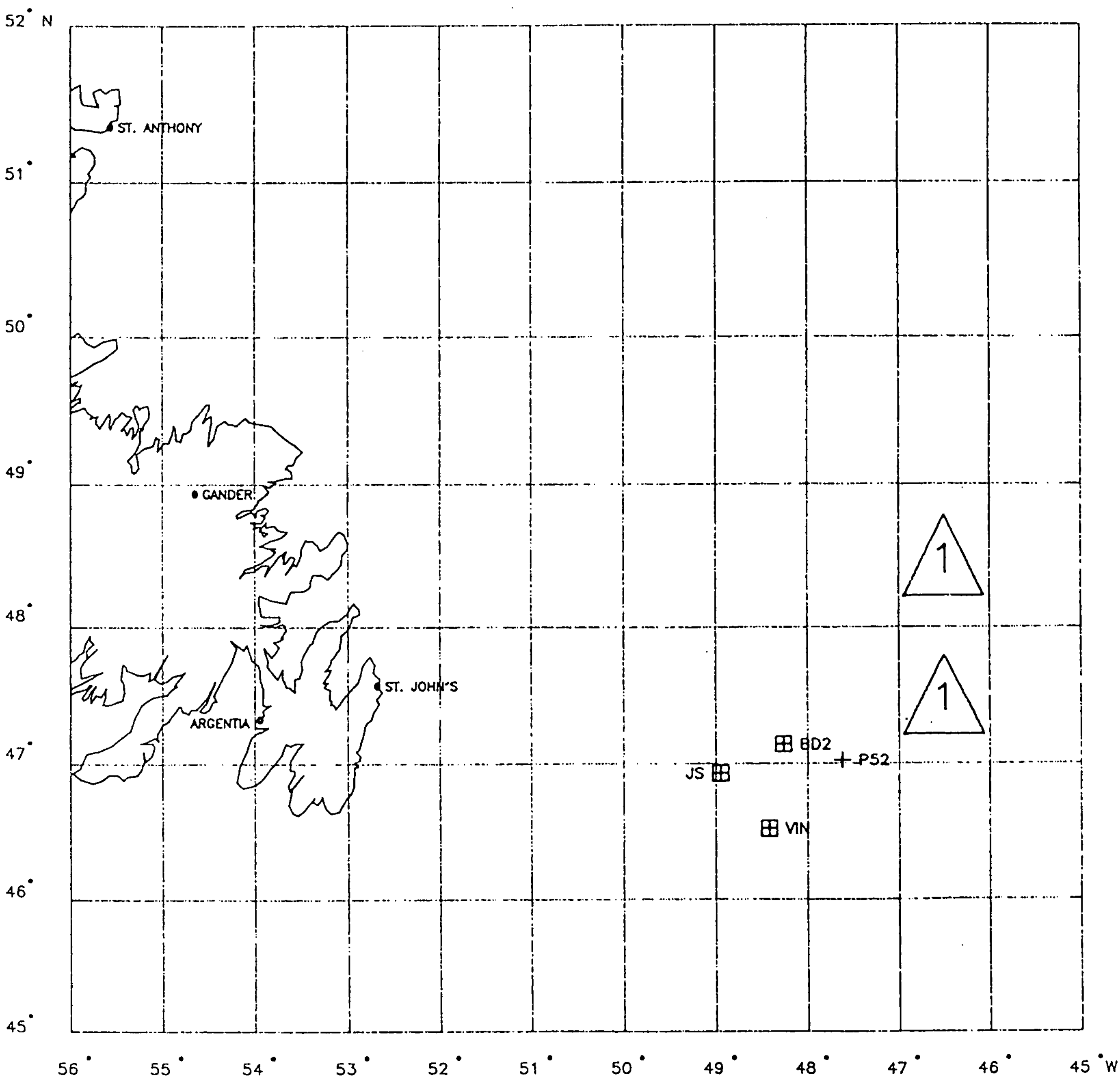
CURRENT LEVEL OF SERVICE: 1 - Data Products are updated 00:00 - 08:00 NDT

ESTIMATED ICEBERG CONCENTRATIONS

VALID TIME : 85-07-23 19:30 NDT   REPORT # 285   PRODUCT : 1-1

RIG : ⊡   WELL : +

△# NUMBER OF ICEBERGS IN GRID CELL



GRAND BANKS OPERATORS ICE DATA MANAGEMENT SYSTEM

NEWFOUNDLAND WATERS REGIONAL ICE MAP

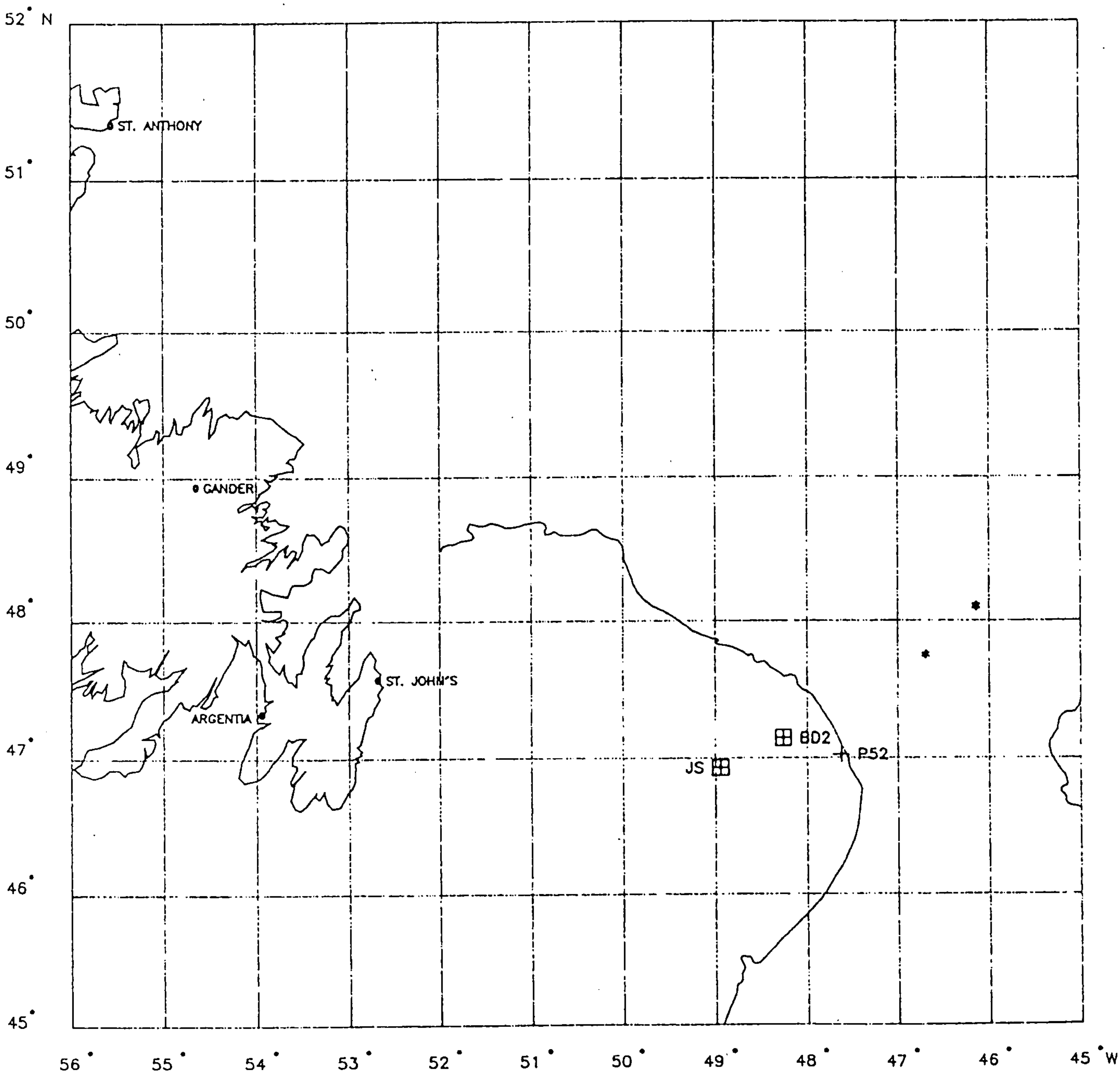
VALID TIME : 85-07-23 19:30 NDT REPORT # 285 PRODUCT : 1-2

RIG : ⊡ WELL : + ESTIMATED ICEBERG POSITIONS : *

ESTIMATED ICE EDGE FIRM ESTIMATE

AES EGG CODE :

200 METER CONTOUR :



GRAND BANKS OPERATORS ICE DATA MANAGEMENT SYSTEM

RIG SITE ICE MAP

FOR : JOHN SHAW | SCALE : 30 nm

VALID TIME : 85-07-23 19:30 NDT | REPORT # 285 | PRODUCT : 1-5-0

RIG : ⊡ WELL : +

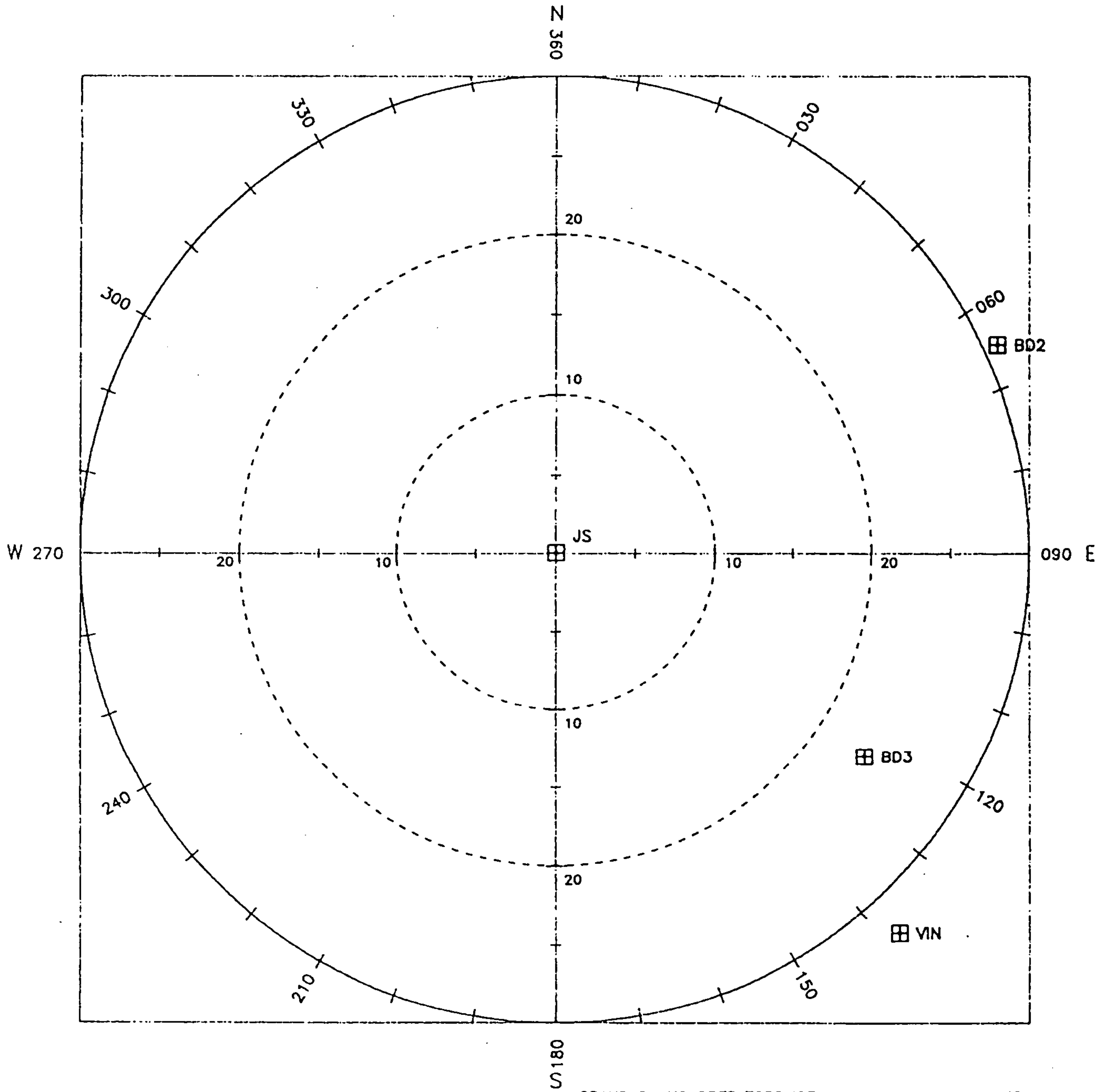
ESTIMATED ICE EDGE — FIRM / ESTIMATE

ESTIMATED ICEBERG POSITIONS : Δ

SIZE

- BERGY BIT
- SMALL
- MEDIUM
- LARGE

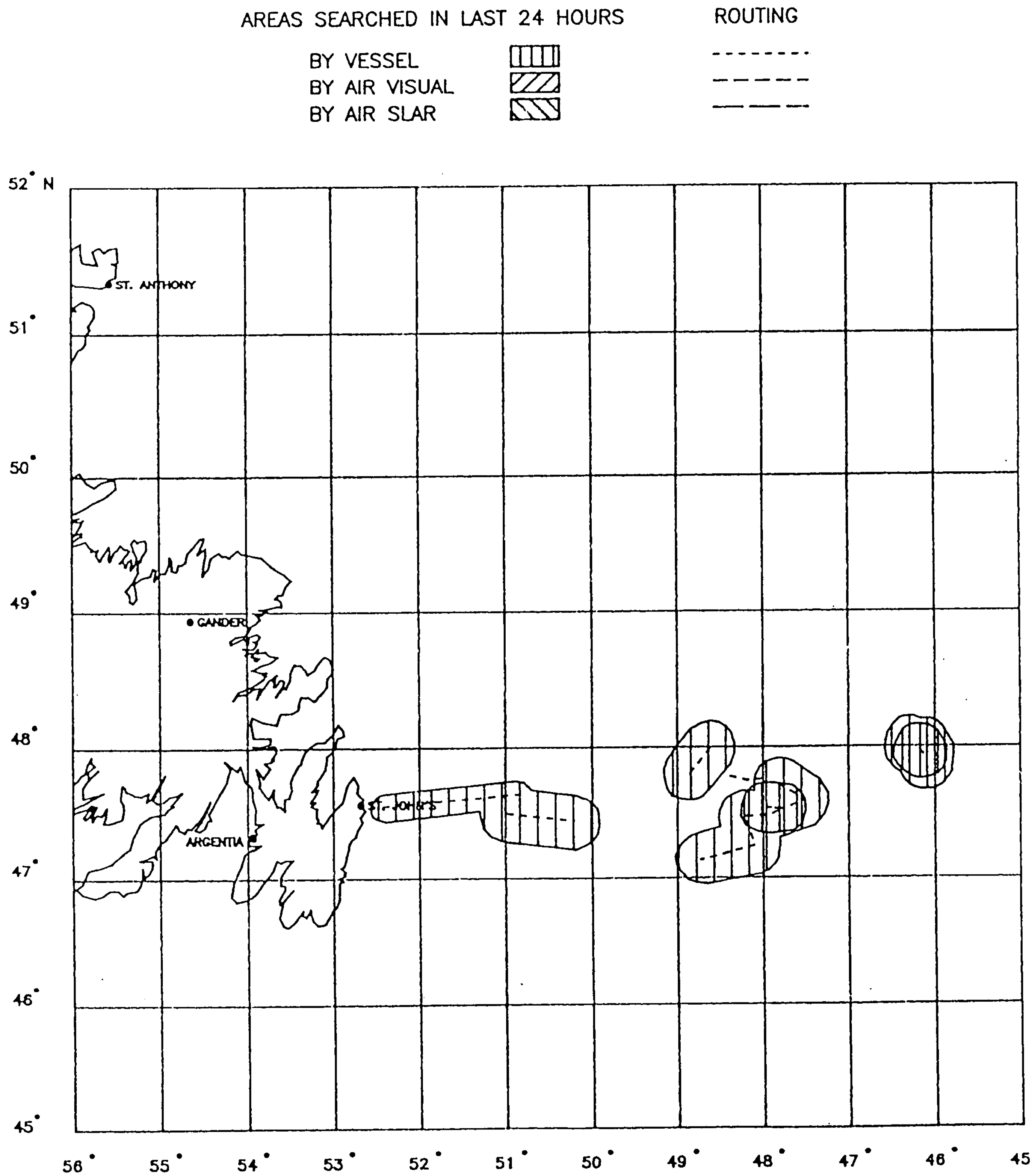
200 METER CONTOUR : ———



GRAND BANKS OPERATORS ICE DATA MANAGEMENT SYSTEM

AREAS SEARCHED MAP

VALID TIME : 85–05–25 07:30 NDT   REPORT # 168   PRODUCT : 1–6



GRAND BANKS OPERATORS ICE DATA MANAGEMENT SYSTEM

GRAND BANKS AREA ICE MAP – FORECAST VERSION

VALID TIME : 85–02–26 07:30 NST   REPORT # 51   PRODUCT : 2–1

RIG : ⊡   WELL : +

ESTIMATED ICE EDGE   FIRM / ESTIMATE

24 HOUR FORECAST : +/– 7 nm

48 HOUR FORECAST : +/– 17 nm

AES EGG CODE :

OBSERVED ICEBERG TRACK :

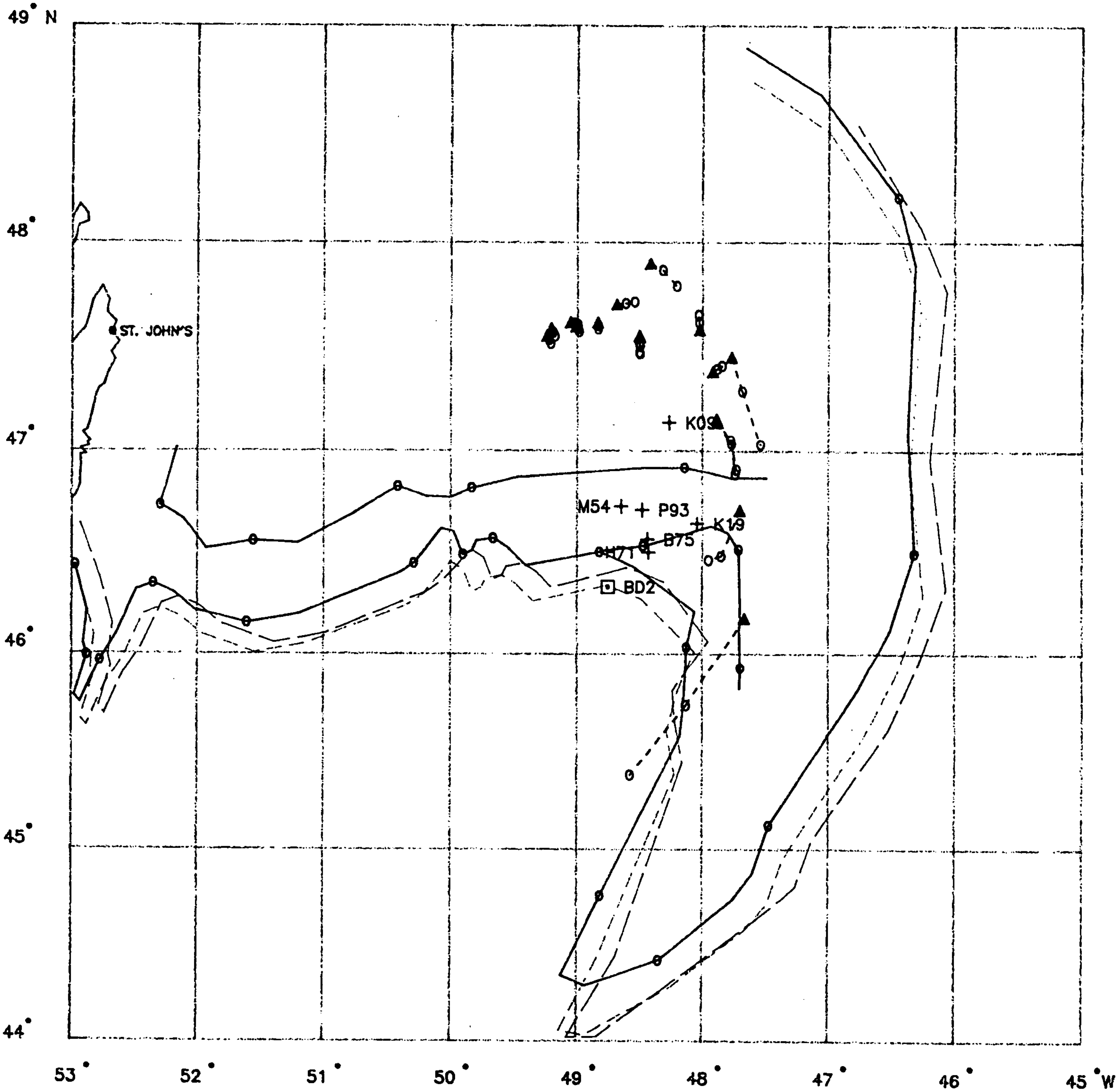
LAST OBS. POSITION △

FORECAST ICEBERG TRACK :

EST'D. PRESENT POSITION : ▲

FORECAST POSITION : O

FORECAST INCREMENT : 24 HOURS



GRAND BANKS OPERATORS ICE DATA MANAGEMENT SYSTEM

RIG SITE ICE MAP – FORECAST VERSION

FOR : MARA M–54 SCALE : 50 nm

VALID TIME : 85–02–26 07:30 NST REPORT # 51 PRODUCT : 2–3–0

RIG : ⊡ WELL : + VESSEL : (vessel symbol)

ESTIMATED ICE EDGE (FIRM / ESTIMATE)

24 HOUR FORECAST : +/– 7 nm

48 HOUR FORECAST : +/– 17 nm

OBSERVED ICEBERG TRACK :

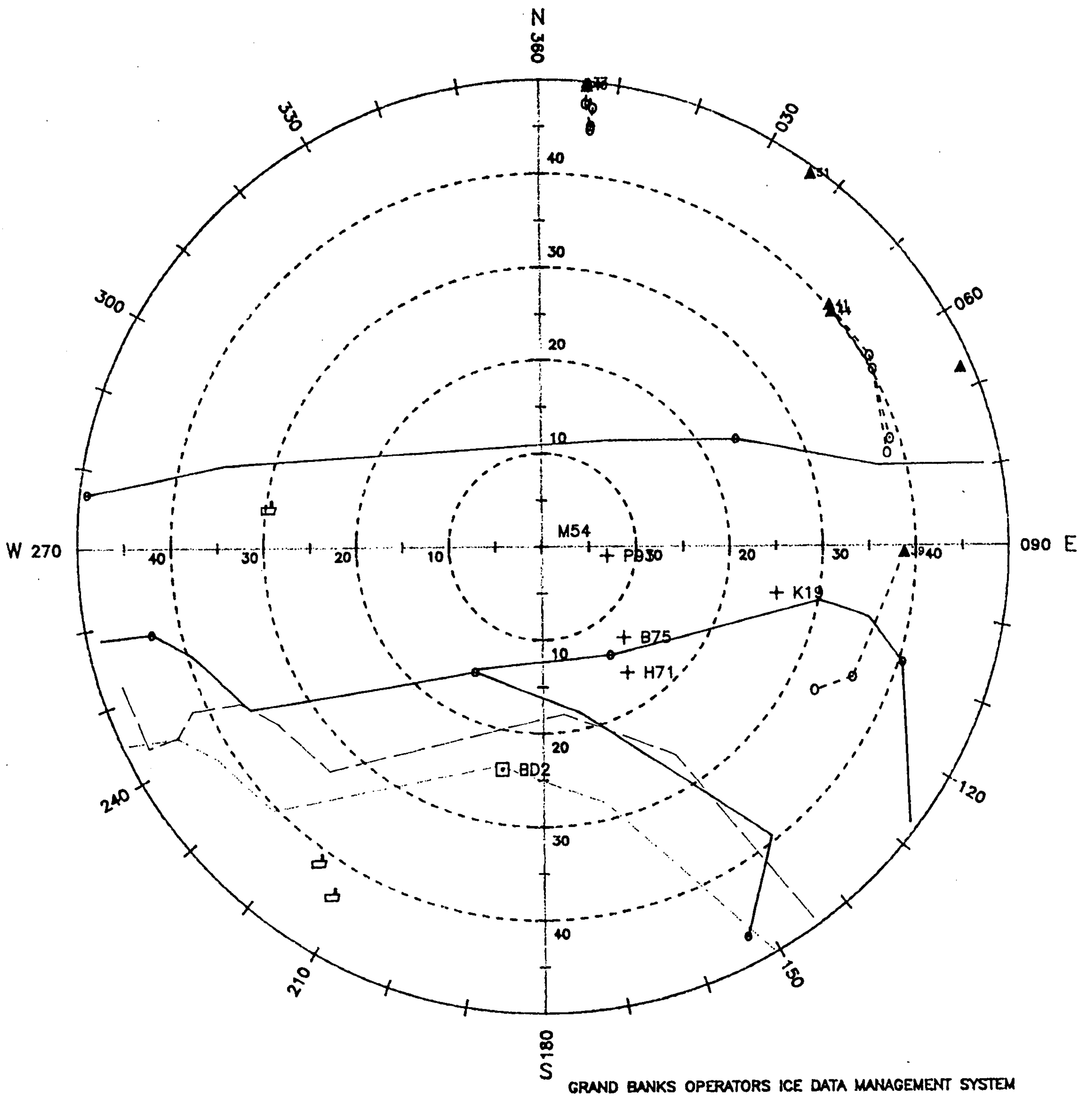
LAST OBS. POSITION △

FORECAST ICEBERG TRACK :

EST'D. PRESENT POSITION : ▲

FORECAST POSITION : O

FORECAST INCREMENT : 24 HOURS



GRAND BANKS OPERATORS ICE DATA MANAGEMENT SYSTEM

FORECAST ICEBERG POSITIONS - RANGE AND BEARING FROM RIGS/WELLSITES

REPORT #285 PRODUCT: 3-3

VALID TIME: 85-07-23 19:30 NDT

DAY/TIME NDT
RANGE/BEARING
(nm.) (degT)

FROM: BOW DRILL 2 / CONQUEST K-09

BERG	PRESENT	24/0730	24/1930	25/0730	BERG	PRESENT	24/0730	24/1930	25/0730
T1737	73.8/059	75.1/061	76.4/064	79.9/066	T1739	103.5/055	107.4/054	110.1/053	112.1/053

FROM: BOW DRILL 3 / NORTH BEN NEVIS P-93

BERG	PRESENT	24/0730	24/1930	25/0730	BERG	PRESENT	24/0730	24/1930	25/0730
T1737	96.2/048	96.9/050	97.5/052	100.3/054	T1739	126.6/047	130.7/046	133.5/046	135.4/046

T=UNDER TOW X=GROUNDED N=NUMEROUS TARGETS

FORECAST CLOSEST SEA ICE - RANGE AND BEARING FROM RIGS / WELLSITES

VALID TIME: 85-01-13 07:30 NST

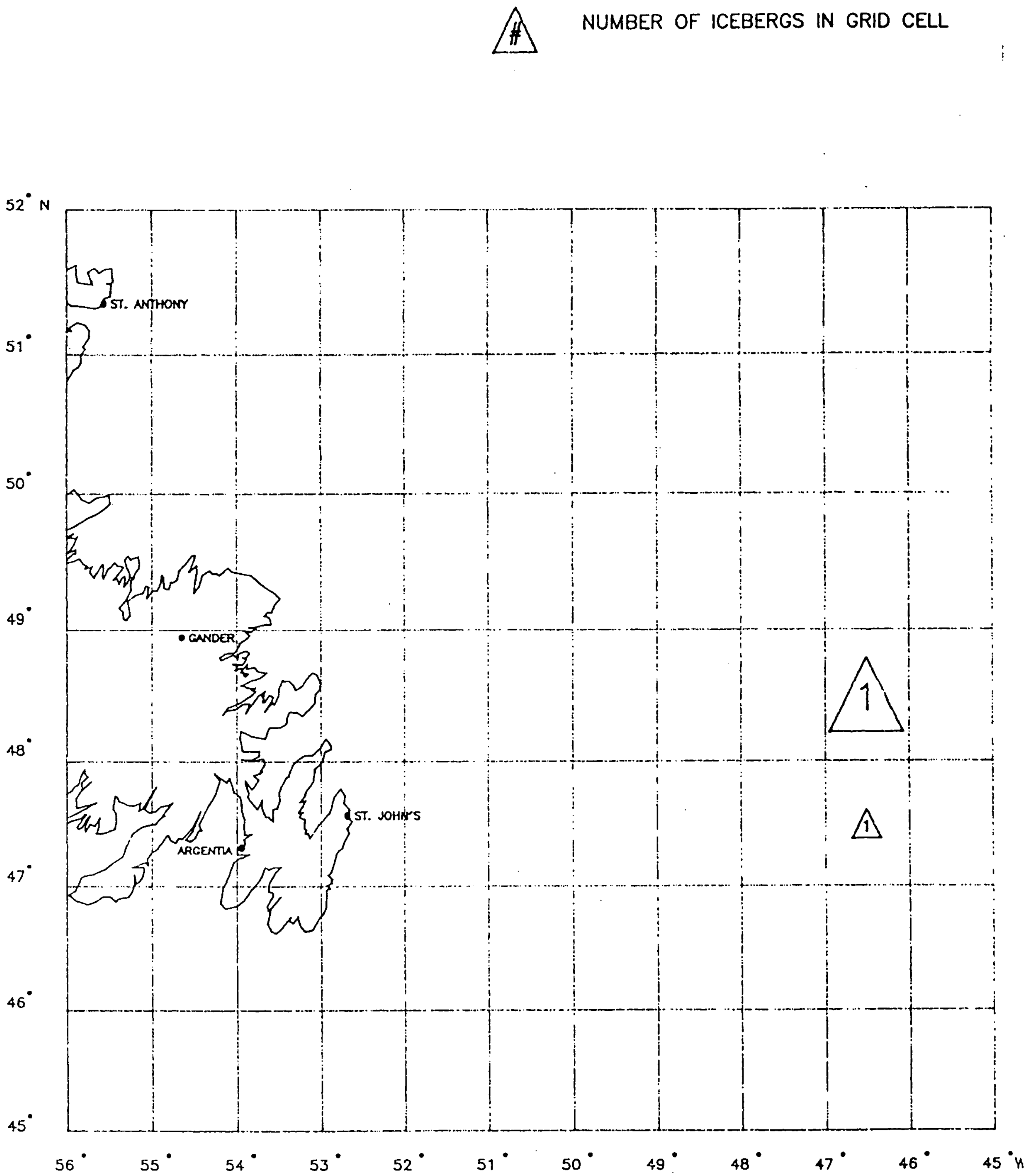
REPORT # 2 PRODUCT: 3-4

DAY/TIME NS
RANGE (n.m.) / BEARING (deg T)
ERROR ESTIMATE (+/- n.m.)

RIG/WELLSITE	PRESENT	13/1930	14/0730	14/1930	15/0730
BD1/B75	110/349 2	106/348 7	102/349 12	99/347 17	100/345 22
BD2/K19	78/339 2	75/338 7	70/339 12	69/335 17	70/333 22
BD3/P93	101/349 2	97/348 7	93/350 12	90/347 17	91/345 22
706/P52	96/326 2	93/325 7	88/325 12	88/322 17	90/320 22
JS /M54	99/352 2	95/352 7	91/354 12	88/351 17	88/349 22

LAST OBSERVED ICEBERG CONCENTRATIONS

VALID TIME : 85-07-23 19:30 NDT   REPORT # 285   PRODUCT : 5-1



GRAND BANKS OPERATORS ICE DATA MANAGEMENT SYSTEM

NEWFOUNDLAND WATERS REGIONAL ICE MAP – LAST OBSERVED

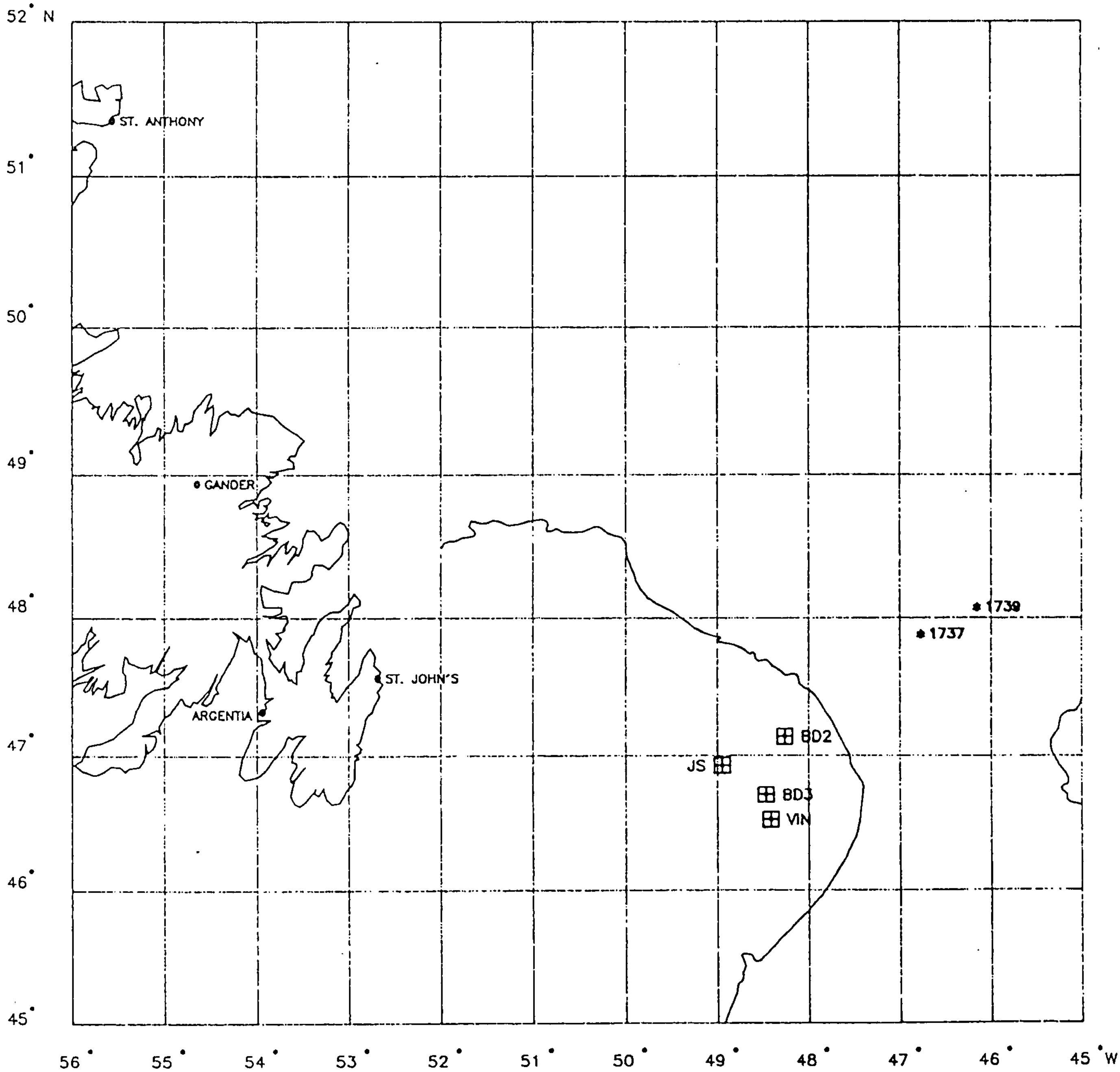
VALID TIME : 85-07-23 19:30 NDT   REPORT # 285   PRODUCT : 5-2

RIG : ⊡   WELL : +   LAST OBS. ICEBERG POSITIONS : *

LAST OBS. ICE EDGE   FIRM   ESTIMATE

AES EGG CODE :

200 METER CONTOUR : ———



GRAND BANKS OPERATORS ICE DATA MANAGEMENT SYSTEM

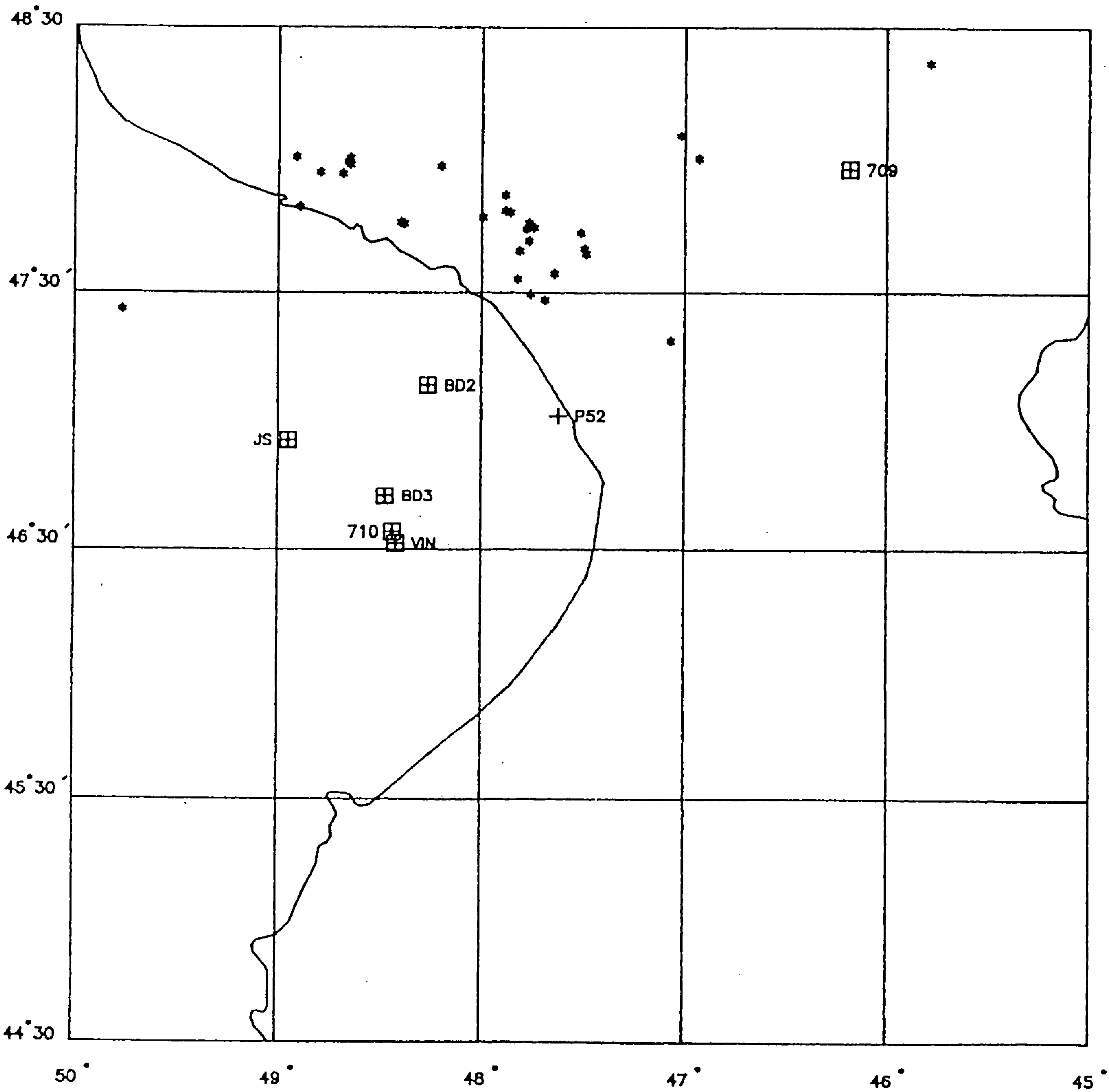
DRILLING AREA ICE MAP – LAST OBSERVED

VALID TIME : 85–05–25 07:30 NDT REPORT # 168 PRODUCT : 5–4

RIG : ⊡ WELL : + LAST OBS. ICEBERG POSITIONS : *

LAST OBS. ICE EDGE FIRM / ESTIMATE

200 METER CONTOUR : ———



GRAND BANKS OPERATORS ICE DATA MANAGEMENT SYSTEM

RIG SITE ICE MAP – LAST OBSERVED

FOR : VINLAND SCALE : 50 nm

VALID TIME : 85-07-23 19:30 NDT REPORT # 285 PRODUCT : 5-5-0

RIG : ⊡ WELL : +

LAST OBS. ICEBERG POSITIONS : Δ

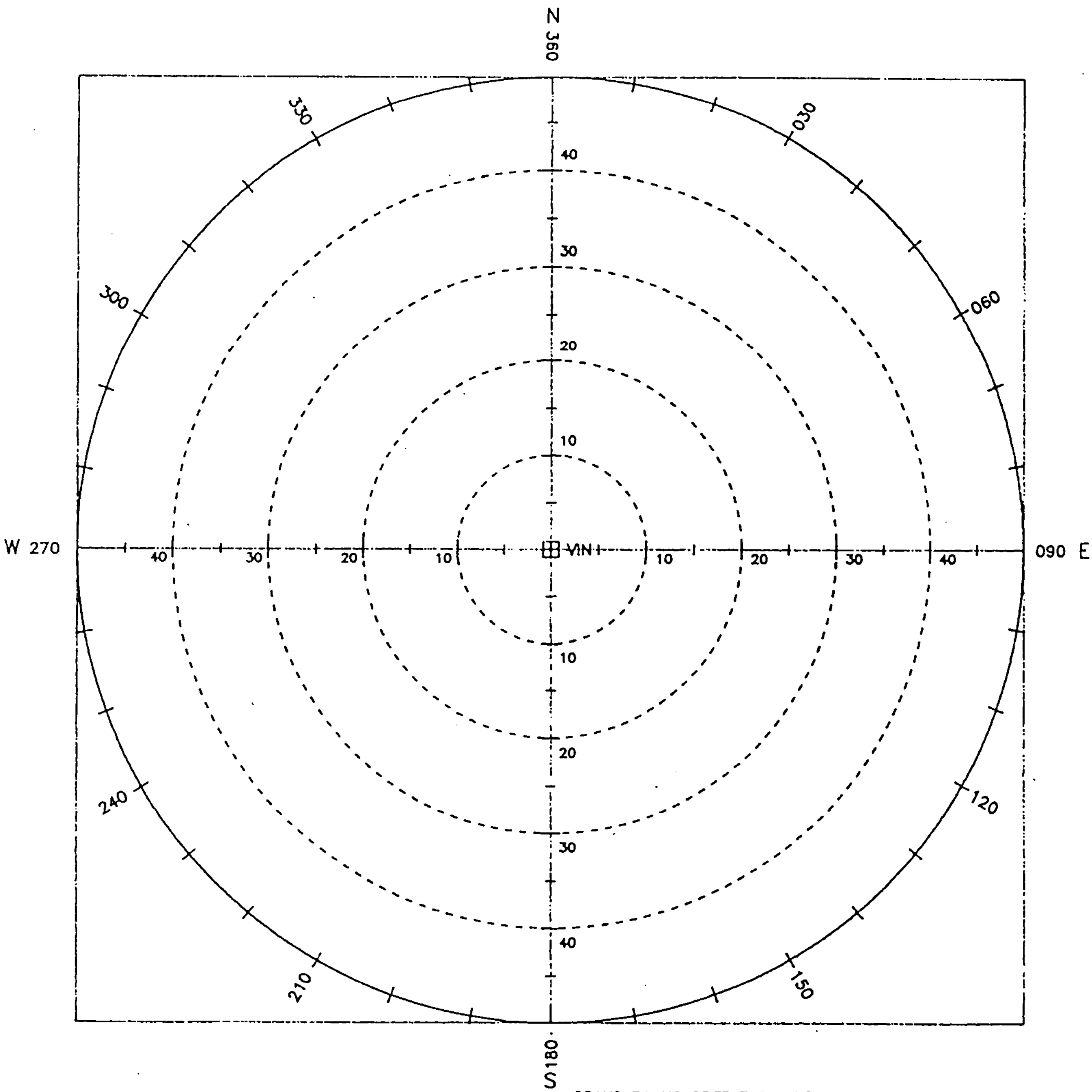
LAST OBS. ICE EDGE FIRM ESTIMATE

SIZE

BERGY BIT
SMALL
MEDIUM
LARGE

200 METER CONTOUR : ———

OBSERVED TRACK



GRAND BANKS OPERATORS ICE DATA MANAGEMENT SYSTEM