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CANADIAN TRANSPORTATION RESEARCH FORUM
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T.B. Smith 3.3.82

HYDROGRAPHIC REQUIREMENTS
FOR
ARCTIC SHIPPING CORRIDORS

The Canadian Hydrographic Service (C.H.S.) has the statutory authority to survey all the navigable waters of Canada and publish this information in nautical charts and related publications.

Section 1.16 of the Canada Shipping Act dealing with Chart Publications Regulations also specifies 'that every ship over loo tons must have the latest edition of the Canadian Hydrographic Charts, Sailing Directions, or equivalent on board and make proper navigational use of' when navigating in Canadian waters. This would leave one to believe that there are suitable C.H.S. charts covering all Canadian waters. This is not so, as much of the Arctic is not charted to present navigational standards. The above also implies that C.H.S. has the duty to produce suitable charts if none are available. Again, C.H.S. has the statutory authority and not the statutory duty to produce charts, and if a mariner chooses to navigate in uncharted waters, he does so at his own risk. However, C.H.S. is required by law to give appropriate publicity to any dangers to navigation which it has knowledge. This provision is contained in both the 1958 Geneva Convention on the Territorial Sea and Contiguous Zone and in the Draft Treaty of the International Convention on the Law of the Sea.

It is obvious from the foregoing that the mission of the Canadian Hydrographic Service is strongly oriented towards marine transportation.

Organizationally, the C.H.S. is part of Ocean Science and Surveys (O.S.S.) of the Department of Fisheries and Oceans. C.H.S. is divided into Headquarters at Ottawa and Regional offices. The major regional offices are at the Institute of Ocean Sciences, Victoria, B.C., The Bayfield Laboratory, Burlington, Ont. and the Bedford Institute of Oceanography, Dartmouth, N.S., a smaller office is located in Quebec City.

T.B. Smith 3.3.82

The development of the C.H.S. program is the result of a co-ordinated planning process with the Headquarters and Regional managers. The program depends on resources, however, an essential requirement to conduct hydrographic surveys in the Arctic is the availability of suitable ships. In all O.S.S. only HUDSON and BAFFIN are ice strengthened and capable of Arctic work. The Canadian Coast Guard has made icebreakers available on both an opportunity and a dedicated basis to chart these waters. These vessels are equipped with launches and use conventional survey techniques to run parallel lines of soundings in open water.

In areas inaccessible to ships, spot soundings are collected on a grid pattern using aircraft and/or tracked vehicles operating from the pack ice. These soundings are fine for scientific purposes but are unsatisfactory for navigational purposes unless they are collected using a very close spaced grid.

Hydrographic surveys, particularly those of the Arctic, are in response to requests from private industry and other government agencies. Going briefly over the history of arctic charting, it will be seen that in 1920 surveys were carried out in Hudson Bay in preparation for the opening of the Port of Churchill and in the mid 1950's to facilitate the construction of Dewline sites. At that time, Canada acquired its first naval icebreaker "Labrador" which carried out surveys during its transits of the Northwest Passage. In the late 50's, Canada turned its attention to establishing firm sovereignty of the Arctic Islands and used scientific research as its tool. Around that time, former P.M. John Diefenbaker was promoting his dream of the Arctic with considerable speculation on mining. To the C.H.S. this meant requests for surveys at various prospective mining sites.

In the early 60's, oil companies began to take an interest in the Arctic and this lead to requests for surveys of proposed landing beaches and pipeline routes. When oil was found at Prudhoe Bay, shipping movement in the North West Passage became more attractive. The voyage of the "Manhattan" in 1969 revealed a new and serious problem with the discovery of *pingo like features (PLF) on the sea floor of the Beaufort Sea. These features are known to exist in depths between 20 and 100m off the Tuktoyaktuk Peninsula from approximately 128°W to 136°W.

The oil companies are forecasting that hydrocarbons will be shipped from arctic fields by the mid to later 1980's and C.H.S. has now turned its attention to surveying the main and alternate shipping routes from known oil and gas fields. (refer to Figure 1). The main route from the Beaufort Sea through the North West Passage using Prince of Wales St. is the best charted but still requires additional work. As previous mentioned, the area of the Beaufort Sea containing the PLF's constitutes a major navigational hazard to the forecasted deep draught shipping (23m) and presents a special challenge to C.H.S. The highest priority in the C.H.S. is to chart a safe corridor through this area. This corridor is 16 km. wide and 280 km. long and is being surveyed using 100m line spacing to give total bottom coverage. It is also being checked by side scan sonar. It will take 2 more seasons, of favourable conditions, to complete the surveys of this area and 2 new charts are scheduled for publication in 1983/84.

Amundsen Gulf is surveyed to modern standards and shown on existing charts 7611 and 7612. Prince of Wales St. has recently been surveyed using over ice techniques on a 500m grid. Conventional ship/launch surveys had been scheduled for this area for the past three years but were aborted due to ice.

The area from Prince of Wales St. to Byam Martin Island has also been surveyed using over-ice techniques with a corridor 30 kilometres wide sounded on a 2000m grid. These depths will be shown on new editions of the existing charts next year. Bridport Inlet, the proposed site of the Liquified Natural Gas port, has recently been surveyed and a new chart (7540), is scheduled for this year. With the exception of some shoal examinations, ranging out to 30 kilometres from the south east coast of Melville Island and south of Bathurst I., the eastern portion of Viscount Melville Sound, Barrow St. and Lancaster Sound are surveyed to modern standards and existing charts 7503 and 7220 reflect this data. The area south of Melville and Bathurst Islands are

Footnote: *Pingoes are hills that have a central core of ice and are found on the Tuktoyaktuk Peninsula.

scheduled for surveys this season. The offshore area through Baffin Bay and Davis St. has not been surveyed to modern standards. This area also presents a unique problem for C.H.S. as ground wave Loran "C" cannot be reliably received north of Cape Dyer. However, this area does not present a navigational hazard as far as depth is concerned if ships stay in the offshore area. The area south of Cape Dyer has been surveyed using a 9 km. line spacing only.

On the southern northwest passage, which is not deep enough for supertankers but is used by general traffic, the picture is not as good. The run through Dolphin and Union St., Coronation Gulf, Queen Maude Gulf and existing through either Peel Sound or Prince Regent Inlet into Barrow St. or through the Gulf of Boothia into Fury and Hecla St. has not been surveyed to modern standards. Existing navigation charts are poor, showing a few lines of track soundings only.

The eastern end of Fury and Hecla St. was surveyed in 1981. These surveys now extend as far south as Hall Beach and the existing chart 7413, will be updated in 1982/83. The Passage from Hall Beach south through Hudson St. has not been surveyed to modern standards and existing charts are compiled from track soundings collected from various ships as they traverse these waterways. The shipping routes from the gase fields around King Christian Island are in a similar state. The routes south through Wellington Channel and east through Belcher Channel have been covered by spot soundings on a 9 km. grid supplemented by a few track soundings and do not meet modern standards for navigational purposes. Charts in this area give an impression that the area is better surveyed than it actually is, although the charts have a number of warning notes attached. Jones Sound is scheduled to be surveyed in detail by the BAFFIN this year.

The Arctic is one of the few frontier areas left in the world. It is a beautiful part of Canada, but it has one of the most hostile environments a hydrographer can encounter. The waters are ice covered for most of the year and presistent wind and currents create enormous pressure ridges. The short summers and cold temperatures of winter combined with the remoteness of the area, makes the logistics of operating a survey in the arctic a feat in itself.

Conventional surveys using a major ship and survey launches can only be carried out in August and September in open water. In areas inaccessible to ships, spot soundings are collected on a grid pattern using aircraft and/or tracked vehicles operating from the pack ice, the -40° temperatures make the efficient operation of both man and machine impossible.

The C.H.S. throughout its history has been very responsive and active in Arctic matters. With the recent increase in Arctic exploration and planned development a great demand has been placed on the C.H.S. to provide adequate navigational charts and related publications. Providing the proposed shipping routes remain unchanged, the C.H.S. will meet these new demands in a timely manner. However, if industrial development requires changes in the shipping routes to areas inaccessible to our ships, then some difficult technological problems must be faced.

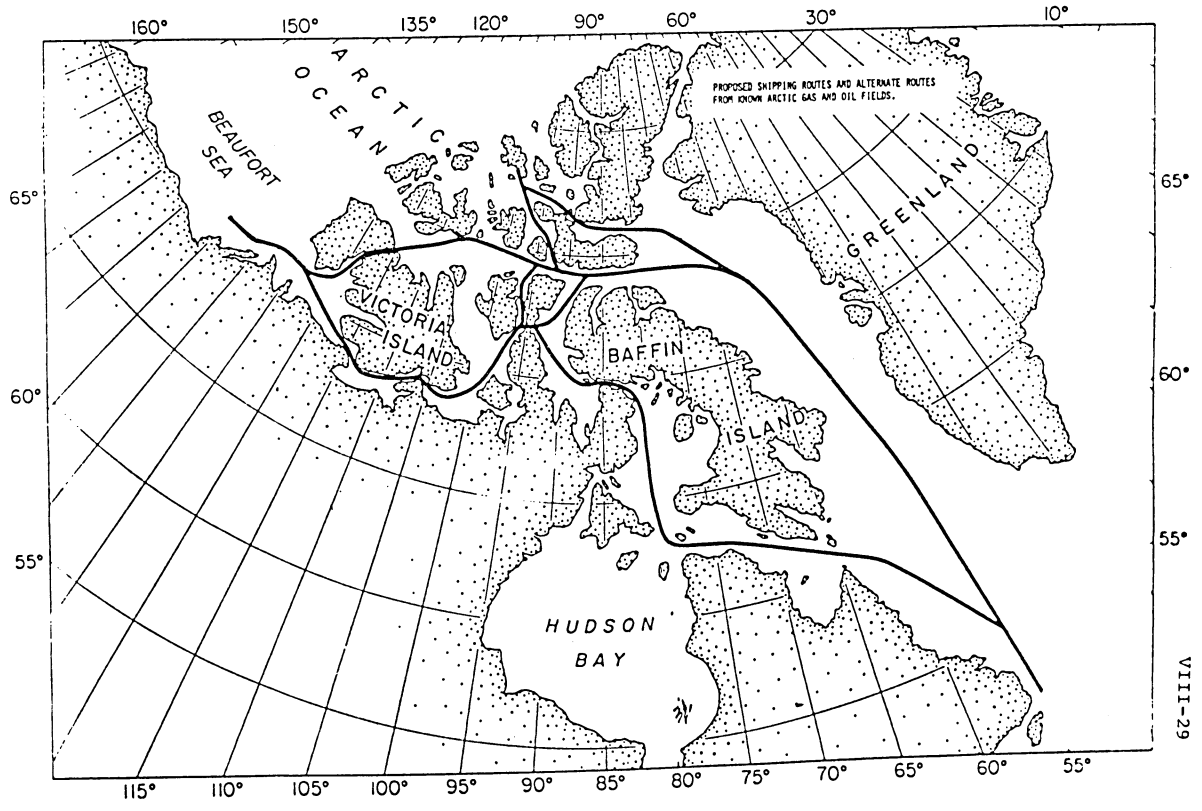
To meet this challenge the C.H.S., with the aid of external funds from the Energy Transportation R&D Programs, is carrying out an active program of technological research. Some of the major programs are outlined as follows.

In areas where conventional surveying techniques are impossible we are looking for alternatives to spot soundings. C.H.S. has been working with industry to develop a high resolution scaning sonar called MARRS (Marine Arctic Route Reconnaissance). The MARRS concept is one of mounting a transducer through a hole in the ice and rotating it through 360°. After one rotation, the angle the transducer face makes with its rotational axis is changed and another rotation of 360° is carried out. In theory, the scan angle can be changed to acoustically sweep a large circular area centered about the hole in the ice. In practice the results have been rather disappointing due to noise and ray bending.

C.H.S. has recently let a contract to develop a unmanned submersible to work under the ice (ARCS). This is a program where an unmanned submersible is placed through an opening in the ice. The submersible steams around an area 10 km. square collecting data while underway.

Also, in cooperation with Sheltech Canada and the University of New Brunswick, C.H.S. is working on developing a navigation package to adapt the NAVSTAR system to the sea environment. The final configuration of NAVSTAR system (in 1987) will consist of 18 satellites and be capable of providing continuous positional information. This will be particularly useful in areas such as Baffin Bay which is presently beyond the use of Loran-C. Other studies are continuously going on to evaluate positioning systems under arctic conditions and to develop better survey instrumentation and techniques using the latest technology in sonar sweeping.

In conclusion, the Canadian Hydrographic Service will remain active in the high Arctic but the area will not be completely and accurately charted in the foreseeable future with our present level of resources and technology. Meanwhile, every effort is being made to provide mariners with sufficient information to allow them to navigate safely along selected shipping routes.


PROPOSED SHIPPING ROUTES AND ALTERNATE ROUTES FROM KNOWN ARCTIC GAS AND OIL FIELDS.
ARCTIC OCEAN
BEAUFORT SEA
VICTORIA ISLAND
BAFFIN ISLAND
GREENLAND
HUDSON BAY
160° 150° 135° 120° 90° 60° 30° 10°
65° 60° 55°
115° 110° 105° 100° 95° 90° 85° 80° 75° 70° 65° 60° 55°