ARCTIC VOYAGE REPORT
1993

CCGS Louis S. St-Laurent

FLEET TECHNOLOGY LIMITED

12 October, 1993

Capt. Phil Grandy
Commanding Officer
CCGS LOUIS S. ST. LAURENT
Coast Guard Base
Dartmouth, Nova Scotia

Dear ~~Capt.~~ Phil Grandy:

On behalf of myself and the staff at FTL, many of whom are intimately familiar with the LOUIS, may I congratulate you on your transit of McClure Strait and circumnavigation of Banks Island.

By all accounts heard here, the trip was a success and the vessel performed well.

Of course I was disappointed that we were not able to take part in the trials, but I am pleased that the vessel has lived up to expectations.

Perhaps it is time for some positive publicity!

Once more, congratulations!

Yours truly,

IAN F. GLEN, P. Eng.,
President

IFG/ks

COPY TO: P. Boisvert, Director General-Fleet Systems

311 Legget Drive, Kanata, Ontario K2K 1Z8 Telephone: (613) 592-2830 Facsimile: (613) 592-4950

Acknowledgement

The Officers and crew of the CCGS Louis S. St-Laurent wishes to express their appreciation for the untiring spirit provided by the management of Maritimes Region, Fleet Systems Ottawa and Coast Guard Northern during the post Mid-Life Refit. To our Commissioner, your acceptance and understanding of the situation made us more determined than ever to sail the CCGS Louis S. St-Laurent. To all of those who provided both physical and mental support we sincerely say ***thank you***.

Introduction and Background

The *CCGS Louis S. St-Laurent* is Canada's largest and most powerful icebreaker. The vessel completed a mid-life modernization in May of 1993, which spanned a five year period and much publicity.

Principal modifications made to the vessel during the modernization project included:

- **Asbestos removal**
- **Hull structure upgrading**
- **Modern bow and air bubbler system**
- **25 Tonne Cargo Crane**
- **Propulsion System**
- **Helicopter Hangar**
- **Refurbished accomodations**

The vessel was accepted from Halifax-Dartmouth Industries Limited on May 07, 1993 and returned to Coast Guard Base Dartmouth to prepare for Arctic Ice Trials 1993.

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Voyage Particulars

Week Number One

August 16 - August 21, 1993

Monday, August 16, 1993

1355 Departed Coast Guard base Dartmouth. Commence transit for High Arctic to conduct Ice Trials. OPSNORD 057/93 refers. This will be the first Arctic voyage for the vessel since 1987. Ship Safety Surveyors (2) on board to complete outstanding regulatory requirements remaining from Sea Trials.

Tuesday, August 17, 1993

Machinery trials and testing for Ship Safety Surveyors ongoing.
Mr. R. Stright, CMF and D. Pepper, Public Affairs on board to prepare for the arrival of W 5 team.

Wednesday, August 18, 1993

1000 Completed Ship Safety requirements. Safety Certificate issued to vessel for am three month period. Certificate short-termed due to abnormal motion at high speeds and main boiler seating.
W5 team arrived on board. Interviews conducted, video of interior and exterior of vessel completed.
1600 W5 team, ship safety surveyors and Regional personnel departed vessel. Vessel proceeding Northward.

Thursday, August 19, 1993

Propulsion set-up with main contractors. Krupp MAK and Siemens tuning system for maximum output.
Vessel entered Straits of Belle Isle, first iceberg sighting.

Friday, August 20, 1993

Propulsion trials/testings and set-up.
Proceeding Northward south Labrador Coast.

Saturday, August 21, 1993

Propulsion trials/testings and set-up completed.
Krupp MAK and Siemens personnel disembark vessel at Cartwright, Labrador.

Week Number Two

August 22 - August 28, 1993

Sunday, August 22, 1993 Proceeding Northward toward Killinek, Ungava Bay to rendezvous with CCGS Pierre Radisson. OPSNORD 076/93 refers.
Monday, August 23, 1993 0900 Anchored Killinek, Ungava Bay. 1035 CCGS Pierre Radisson alongside for fuel transfer. **Transferred 700 M³ diesel bunkers.**
Tuesday, August 24, 1993 0117 Departed anchorage Killinek proceeding toward Radstock Bay, Lancaster Sound to refuel from M/T Rexton Kent.
Wednesday, August 25, 1993 1441 Crossed Arctic Circle. Arctic Circle ceremony in 'Louis' real form conducted.
Thursday, August 26, 1993 Proceeding Northward East Baffin Coast. Crew continuing to work on systems and prepare vessel for Ice Trials.
Friday, August 27, 1993 Entered Lancaster Sound proceeding Westward toward Radstock Bay. Crew continuing to work on systems and prepare vessel for Ice Trials.
Saturday, August 28, 1993 1312 Secured alongside M/T Rexton Kent to refuel to maximum capacity. *Polar Bear* took position on tankers rudder to oversee fuel transfer operations.

Week Number Three

August 29 - September 04, 1993

Sunday, August 29, 1993 0828 Stopped off Resolute for first Ship's Mail lot. 1545 Departed Resolute. Proceeding toward Alert to stand-by for Russian Passenger vessel Kapitan Khlebnikov *UTSU*
Monday, August 30, 1993 Proceeding toward Alert.
Tuesday, August 31, 1993 Proceeding toward Alert.
Wednesday, September 01, 1993 Proceeding toward Alert.
Thursday, September 02, 1993 Proceeding toward Alert.
Friday, September 03, 1993 Proceeding toward Alert. 1038 Received Operation Order OPSNORD AMND 9146
Saturday, September 04, 1993 Proceeding toward Alert.

Week Number Four

September 05 - September 11, 1993

Sunday, September 05, 1993 1530 GPS position Lat. 81° 47' N Long. 62° 14'.2 W. Unable to proceed further North due to Robeson Channel closed with 10 tenth multi year ice giant floe. 1950 commenced voyage south toward Lancaster Sound.
Monday, September 06, 1993 Proceeding toward Resolute.
Tuesday, September 07, 1993 Proceeding toward Resolute.
Wednesday, September 08, 1993 Proceeding toward Resolute.
Thursday, September 09, 1993 Proceeding toward Resolute.
Friday, September 10, 1993 Proceeding toward Resolute. 1345 Anchored Allen Bay.
Saturday, September 11, 1993 Ice Trials monitoring team on board. R. Browne, M. Edgecombe, R. Rich. Instrumentation of vessel ongoing.

Week Number Five

September 12 - September 18, 1993

Sunday, September 12, 1993 Anchored Allen Bay. Instrumentation of vessel ongoing.
Monday, September 13, 1993 Anchored Allen Bay. Instrumentation of vessel ongoing.
Tuesday, September 14, 1993 Anchored Allen Bay. Instrumentation of vessel ongoing. 1909 Departed Resolute proceeding Westward toward M'Clure Strait.
Wednesday, September 15, 1993 Proceeding toward M'Clure Strait. Propulsion personnel tuning system.
Thursday, September 16, 1993 Transited M'Clure Strait. Advised AM Ottawa of this accomplishment.
Friday, September 17, 1993 Conducting Ice trials Northern portion of M'Clure Strait. 1320 Ice Trials team on ice taking ice measurement M +
Saturday, September 18, 1993 Transited M'Clure Strait into the Beaufort Sea, thus completing Parry's Voyage of 1819 - 20.

Week Number Six

September 19 - September 25, 1993

Sunday, September 19, 1993 2137 Anchored Tuktoyaktuk to assist Terry Fox to load cargo.
Monday, September 20, 1993 1600 Departed anchorage Tuktoyaktuk, completed loading Terry Fox. Proceeding Resolute via Prince of Wales Strait.
Tuesday, September 21, 1993 2000 Northbound at entrance to Prince of Wales Strait.
Wednesday, September 22, 1993 Ice Trials Viscount Melville Sound.
Thursday, September 23, 1993 1130 crossed old westbound track, therefore officially circumnavigating Banks Island.
Friday, September 24, 1993 Completed Ice Trials. Stopped off Resolute to disembark Ice Trials Personnel. 1635 Departed Resolute proceeding toward Dartmouth, N.S. 1714 Rec'd OPSNORD to remain Resolute to standby shipping.
Saturday, September 25, 1993 1014 Anchor aweigh proceeding Pond Inlet to standby for shipping.

Week Number Seven

September 26 - October 02, 1993

Sunday, September 26, 1993 0820 Rec'd OPSNORD to return to Coast Guard Base Dartmouth, N.S.
Monday, September 27, 1993 Proceeding toward Dartmouth, N.S. Southbound southern Baffin Bay.
Tuesday, September 28, 1993 Proceeding toward Dartmouth, N.S. Southbound southern Davis Strait and Labrador Sea.
Wednesday, September 29, 1993 Proceeding toward Dartmouth, N.S. Southbound Labrador Sea and entering Strait of Belle Isle.
Thursday, September 30, 1993 Proceeding toward Dartmouth, N.S. Southbound through Gulf of St. Lawrence and Cabot Strait. Attempted to embark SSB and Customs from Sydney, N.S. (helo unable to land Sydney due to fog)
Friday, October 01, 1993 0841 Completed Vibration Trials with SSB to complete outstanding SI 7 requirements. 1045 Secured Coast Guard Base Dartmouth, N.S.. 1222 Cleared customs shore leave granted.
Saturday, October 02, 1993

VOYAGE STATISTICS

ITEM	AUGUST	SEPTEMBER	OCTOBER	*TOTALS*
Time Steamed (hrs)	333.80	447.80	10.60	***792.20***
Distance Run (NM)	3362.90	5097.20	171.00	***8631.10***
Time Stopped (hrs)	8.20	184.92	0.00	***193.12***
Time Anchored (hrs)	28.20	89.30	0.00	***117.51***
Fuel Consumed (M)	518.78	964.98	30.58	***1514.34***
Helicopter Ops (hrs)	30.34	110.62	2.78	***151.80***

Helicopter Activity Report

Canadian Coast Guard
Helicopter Pilot Report on Shipboard Operations
For Period *August 16,1993* to *October 01, 1993*

(complete prior to leaving the ship on all operations of over 1 day in duration)

Helicopter

CG 362 (CFS)

Crew

Pilot: J. Fraser
Engineer: D. Byrne

Fuel on Board: At start of period 27,000 ltr. at end of period 15,395 ltr.

Flying Hours by Activity and Total for Period

68.4 hours FAIS CODE 2202

Ice Reconnaissance and Ship Support

Remarks

Above average co-operation from Ship's Captain , Officers and Crew.

Pilot: J. A. Fraser

Commanding Officer: Capt. P. O. Grandy

Typed from original report

Passenger List

PASSENGER LIST

DEPARTURES:

August 16, 1993	Dartmouth
	J. Lepage, Steward
August 18, 1993	Corner Brook
	H. Lee, Ship Safety
	E. Sheppard, Ship Safety
	J. Rowe, TEW
	D. Hiltz, Quartermaster
	P. Niessen, MaK
	K. Aeffmer, MaK
	D. Pepper, CECA
	R. Stright, CMF
August 21, 1993	Cartwright
	M. Maier
	H. Poloczanski
	M. Eder
	M. Andersen
	C. Kutzner
	G. Difante
	J. Dowthwaite
	L. Soto
	P. Niessen
	K. Aeffner
	A. Quednau

PASSENGER LIST

DEPARTURES:

September 10, 1993	Resolute
	N. Hawksworth, Senior Engineer
	B. McKinnon, TEW
September 19, 1993	Tuktoyuktuk
	M. Maier
	P. Andersen
	R. Arand
	Dr. Sasse
	H. Poloczanski
	A. Quednau
September 24, 1993	Resolute
	I. Cote
	R. Browne
	M. Eder
	A. Walker
	A. Ritch
	P. Neissen
	J. Redican
	M. Edgecombe
	C. Kutzher

PASSENGER LIST

ARRIVALS:

August 18, 1993	Corner Brook
	J. Hilder, Steward
August 21, 1993	Cartwright
	D. Publicover, Quartermaster
September 10, 1993	Resolute
	C. Berube, TEW
September 11, 1993	Resolute
	R. Browne M. Edgecombe R. Ritch

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PASSENGER LIST

ARRIVALS:

September 14, 1993	Resolute
	A. Walker, USCG
	R. Arand, MaK
	M. Maier, Siemens
	P. Andersen, Siemens
	Dr. Sasse, Siemens
	H. Poloczanski, Siemens
	A. Quednau, Siemens
	J. Redican, Project Manager
	P. Niessen, Siemens
	I. Cote, CG Northern
	M. Eder, Siemens
	C. Kutzher, Siemens
	G. Difante, Siemens
September 24, 1993	Resolute
	R. LaPorte

Ice Observer's Report

Ice Information

The vessel entered Smith Sound on Aug. 31, and encounteredloose ice conditions varying from 3 to 5 tenths in the easternSound. In southern Kane Basin ice concentrations increased to 8tenths multi year with patches of 9 plus tenths. On Sept. 2,the vessel crossed Kane Basin to encounter better ice coditionsof 6 tenths multi year along the Ellesmere Island coast. In Kennedy Channel, the vessel encountered loose ice conditionsvarying from 5 to 8 tenths multi year. On Sept. 3, a lead hadformed in eastern Kennedy Channel and extended into Hall Basin where conditions tightened to 9 tenths multi year, with congested areas of 9 plus tenths. On Sept. 5, a helicopter ice reconnaissane indicated loose ice conditions of 5 to 8 tenths to 82N then 9 tenths multi year ice into the Lincoln Sea. In the afternoon a second ice reconnaissane indicated that a slight wind shift had congested the ice in Robeson Channel. A giant multi year floe blocked more than half the channel, with a second giant floe ready to block the remainder of the channel.

The return journey through Nares Strait commenced on Sept. 5, with similar ice conditions encountered. Loose ice conditions were encountered along most of the Greenland coast. Congested multi year ice conditions were encountered in northern Smith Sound, but loosened to 5 tenths in the southern sound. No first year ice was observed on the trip. The average ice thickness was 2 to 2.5 meters, although floes up to 7 meters were encountered. The predominant floe size was medium and small with about 3 tenths of vast floe.

On the evening of Sept. 14, the vessel departed Resolute bound for McLure Strait. 2 to 3 tenths of small floe multi year ice was encountered from Resolute to eastern Viscount Melville Sound. From longitude 108 westward to McLure Strait ice concentrations increased to 8 to 9 tenths multi year with 3 tenths vast floe. The vessel traversed one vast floe with an average thickness of 3 meters. Surprisingly, very little ice was encountered in the entire McLure Strait, with only 1 to 2 tenths of multi year ice in the entire strait to 12040 W, where ice trials commenced. The ice trials were conducted in various ice concentrations wherever suitable ice floes were found.

Ice Information

On the return voyage to Resulute via Prince of Wales Strait, 6 to 7 tenths multi year ice was encountered in the central strait, with only 3 tenths of ice in the southern and northern strait. Crossing Viscount Melville Sound 8 to 9 tenths of multi year ice was encountered in the southern sound areas, loosening to 6 to 7 tenths multi year ice with 2 to 3 tenths new ice in the northern sound. From longitude 108 eastward new ice predominated with only 2 tenths multi year ice to within 80 miles of Resolute, where open water was encountered for the remainder of the trip to Resolute.

Engine Room Report

Propulsion System

The St-Laurent's diesel-electric propulsion system is a blend of new and old machinery. The engines, electrical generation and control systems are new, while the three propulsion motors, shafting and propellers are original equipment. In a marriage of two generations of technologies difficulties are expected. Predictably, numerous challenges had to be addressed during the voyage. The crew dealt diligently with these and none proved insurmountable.

The multi-engine installation permitted a precise match of power output to suit prevailing ice conditions. The overall performance of the plant, and it's capability in ice and open water were remarkable. The ships demonstrated significantly improved performance in heavy ice with drastically lower fuel consumption. In an average day of icebreaking, the engines burned less fuel the old steam plant consumed in 24 hours at anchor. Open water trials showed higher speed obtained at lower power levels than recorded during the original builders trials.

It appears that the change in bow form and waterline length have also created an undesirable side-effect. The wing propellers mill more ice, this increases the risk of blade damage. The present propeller design and material should be assessed to see if a change in the alloy or setting a different pitch diameter ratio for each shaft will provide a reasonable benefit.

Action to address localized structural vibration was successfully completed during the arctic trip. Ship's crew fabricated and fitted beams and pillars to support weight concentrations on the converter room deck. The installation of this additional stiffening under the converter room eliminated the unacceptable vibration experienced in this area.

Difficulties were encountered with cooling systems for main and auxiliary equipment. In particular, the design, configuration and installation heat exchangers, isolation provisions and de-icing facilities for auxiliary seabays have demonstrated serious shortcomings. Similarly, the lack of considerations for access to main and auxiliary machinery, to conduct maintenance, is a serious impediment to the effective and efficient use of limited personnel. Measures to correct these items has been initiated.

Propulsion System

Overall the plant delivered outstanding performance under arduous conditions, with a level of economy typical of a ship several classes smaller. It is noteworthy, no serious propulsion component failures were experienced.

Bow and Bubbler System

The Bow and Bubbler System was designed and installed in the vessel to comply to CASPPR 4 standards and is of a completely fabricated construction. The bow is transversely framed at 16 inch centres with slab flat bar stiffeners, flanged stringers and fabricated tee section web frames. The internal deck structure is longitudinally framed. Integral with the new bow is the air bubbler system. From the ice trials it was found that although the bubbler was not required for actual ice transit, it was found to have positive influence by a weaker stress measurement on the girders.

Logistics Report

LOGISTICS REPORT

9660 meals were served during the Arctic voyage from August 16 to October 1, 1993.

Passengers were received throughout the voyage. Accommodations for passengers and ship's personnel were single berth lodgings, excepting Officials Cabins. This greatly increased moral onboard.

Washrooms on the Main Deck were adequate in terms of number of wash spaces and toilets in proportion to the number of users. However, the washrooms require maintenance (decks in showers should be repaired and repainted). The toilets were often out of service due to a mechanical malfunction, therefore, extra cleaning was required to maintain the normal high standard of cleanliness.

Stores were received onboard the vessel prior to departure. Fresh produce and milk were received in Resolute from Dartmouth suppliers on the chartered flight provided for the CCGS Terry Fox crew change. Storage space onboard, including fridge spaces, were ample for requirements.

Supply Department staff was reduced. Normal complement consists of eight Stewards (SC STD 01) and one Senior Steward (SC STD 02). Five Stewards were carried on the voyage with no Senior Steward. Work schedules were re-arranged in order to permit regular duties to be carried out, plus the extra duties involved when carrying passengers, without incurring excessive overtime. The Ship's Clerk position was vacant. Two Cataloguers were carried to accommodate the cataloguing requirement incurred from a five-year refit. The Cooks hours were staggered to permit the maximum allotment of time to be available for cleaning of the Galley during quiet hours and for extra baking and preparation work (more fresh vegetables created more prep work).

LOGISTICS REPORT

Laundry services for bed linen and coveralls was provided. Laundry equipment available was sufficient for the requirement.

The Messing areas onboard provided ample seating arrangements for meals. The meal hours afforded enough time for watchkeepers, regular personnel and passengers to be provided with meals.

Summary of Mail Surface

Summary of Mail Service

RECEIPTS:

August 29, 1993	Resolute	
		LSSL200893-01
		LSSL200893-02
September 11, 1993	Resolute	
		LSSL250893-03
		LSSL270893-04
		LSSL010993-05
		LSSL080993-06
		LSSL080993-07
September 24, 1993	Resolute	
		LSSL140993-08
		LSSL140993-09
		LSSL170993-10

DISPATCHES:

August 29, 1993	Resolute	
		LSSL280893-01 (Dartmouth)
September 24, 1993	Resolute	
		LSSL220993-11 (Ottawa)

Medical Report

Medical Report

Medical Report

The following is an excerpt from Nurse Susan McCowan

Orientation by Health Canada for duties aboard ship was satisfactory, however, it should be clarified prior to sailing where to contact physicians "after hours" when needing consult for urgent cases at sea.

The amount of medical supplies and prescription drugs were adequate for the length of the voyage (7 weeks). Items that have been suggested to be added to the scale of issue include Multistix with leukocytes, pill bottles, decongestants (e.g. Sudafed or sinutab), muscle relaxants (e.g. Robaxin), Oragel, Duofilm, and Gravol Tabs. Demerol 100mg/ml amps have been suggested to be added to the narcotics list. Other items required include a clinical height weight scale, Flynn suction unit, oxygen tanks with masks/cannulas, and an I.V. pole and/or wall hook.

There were only two evacuations during the trip. One urgent case of a patient with renal colic; and a non-urgent case of a patient with query fractured left ankle. No problems were incurred during these medevacs which were run smoothly and efficiently (see August month end report).

Health education/promotion materials supplied were satisfactory. Health pamphlets for patient teaching proved helpful (e.g. diabetes, back pain, weight loss). Video tapes borrowed from Health Canada were periodically shown onboard and were received with some enthusiasm (e.g. BP, nutrition, skin wellness). Most texts supplied were current and informative. A good text on muskoskeletal injuries and their management may be a beneficial addition. A talk on hypothermia was done by the nurse as part of the fire and boat drill for all Crew members.

The Medical Officer was invited to go on weekly rounds with the Captain, Chief Engineer, Chief Officer and Logistics Officer. This included inspection of the galley, cabins, washrooms, refrigeration storage areas, engine room, sick bay, Crew and Officer lounges and board room.

Medical Report

The following is an excerpt from Nurse Susan McCowan

The Ships Crew were comfortable coming to the Nurse for medical/nursing assistance. Likewise, the Crew were excellent to work with and any small problems arising during the voyage were dealt with in a professional manner. Overall, the trip went extremely well.

Recommendations on Aids to Navigation

Recommendations for Aids to Navigation

Install second G. P. S. for Back-up and Gyro Pilot Steering above 82° N.

New Sperry Radars to be G .P. S. stabilized for Nav-Line feature.

Anschutz Gyro correction (delta) control to be investigated for high latitude navigation.

General Observations and Recommendations

General Observations and Recommendations

The vessel was well equipped under conventional methods for crew entertainment with video and audio mediums. It was well noted during the voyage that there was something missing, even with all the state-of-art equipment. During the several visits to Resolute area the television sets were the focal point of interest for all concern.

I would urgently suggest that some energy be expended toward a pilot project for a shipboard entertainment system on major icebreakers. With the future demands that is expected to be placed on this vessel, I would suggest that the 'Louis' be provided the opportunity to participate in such a venture.

Significant Events (Ship's Electronics)

Ship's Electronics

G. P. S. proved to be a reliable, accurate and operator friendly navigation aid.

The inmarsat MX 211 terminal is considered obsolete, and should be replaced by the latest proven terminal that can accomodate both voice and fax traffic. This unit should be installed prior to Arctic Voyage 1994. Approximately $ 2500.00 worth of poor connection for facsimile transmission was tracked during this voyage.

Communications during the voyage leg to Alert was carried out mostly by the Ham Operators on board.

All other minor problems were corrected by the on board technician. After a five year period undergoing major repairs, the vessel did extremely well in way of electronics.

Commanding Officer's Report

Voyage Summary

The vessel departed Dartmouth Coast Guard Base on Monday, August 16, 1993 as planned for the first Arctic Voyage since 1987. Since August 1988 the vessel have been undergoing Mid-Life Modernization Refit.

The Arctic Operations OPSNORD 057/93 determined that the vessel would assume most of the tasks outlined for the CCGS Pierre Radisson. The Ops Order soon made a drastic change when the Russian passenger vessel Kaptain Khlebnikov *UTSU* circumnavigating Greenland found difficult ice conditions in the Lincoln Sea . This would become the first International tasking in the HIGH Arctic.

The period August 16 - August 29, 1993 the vessel transit from Dartmouth, N.S. to Resolute, NWT. While enroute Ship Safety and propulsion personnel carried test/trials on the propulsion systems. In addition, the vessel transferred 700 cubic meters of fuel to the CCGS Pierre Raddison and received 1365 cubic meters from the M/T Rexton Kent.

The period August 30 - September 11, 1993 the vessel's transit encompassed the North Baffin Bay into Nares Strait, Kane Basin, Kennedy Channel, Hall Basin and Robeson Channel. This transit provided a most Northerly position of Lat. 81 47 N Long. 62 14.2 W. At this position the vessel encountered giant multi-year ice floes blocking Robeson Channel completely.

While in the Alert area personnel were exchange between the Alert base and the CCGS Louis S. St-Laurent.

September 12 - September 24, 1993 the vessel conducted ice trials in the western extreme of Viscount Melville Sound through the M'Clure Strait into the Beaufort Sea. During this transit ice trials were conducted in level ice ranging from 3 to 4.5 meters mostly multi-year ice. Ridging and hummocks determined sail heights of up to 15 meters. The vessel successfully rammed through those areas and completed the Ice trials.

Voyage Summary

The vessel responded to a task to assist the CCGS Terry Fox with the loading of cargo in the Tuktoyaktuk area. All cargo was successfully loaded from the cargo barge and transferred to the Terry Fox.

The return transit from Tuktoyaktuk via the Prince of Wales Strait served to circumnavigating Banks Island from East to West and return. It was on the return voyage the vessel encountered severe ice conditions ranging from 4.5 metres to 8 meters.

Ice Trials

The objective of the ice trials was to measure the parameters of the vessel with the new fitted bow and propulsion systems. The procedure to accomplish this objective was to select the best uniform ice with a growth of 2 - 3 meters. In the area of testing it was found that this model of ice did not exist and therefore all testing would have to be done in ice growth of 3 - 4 meters with ridging and hummock of 12 to 15 meters.

Integration with other systems was important, therefore the shafts were instrumented as well as the propulsion systems hull girders and deck framing.

The trials route took the vessel west to Tuktoyatuk via M'Clure Strait returning to Resolute via Prince of Wales thus circumnavigating Banks Island. During the voyage, the vessel encountered a wide range of ice regimes, and significantly, several heavy multi-year ice regimes. Recordings were made continuously of the vessel's position. speed and track, the ice conditions encountered, engine power and the hull stresses resulting from ice contact.

The vessels bow was very effective in lifting smoothly and applying the vessel's weight to break thick old ice features, the large thrust available being applied in short controlled slow speed rams . The turning ability of the vessel in heavy ice conditions was impressive.

In addition to ice trials, a number of open water speed and power runs and bollard push tests were recorded, documenting the ship's track and speed from the GPS on a common time base with the shaft power and rudder position.

It can be concluded that the Ice trials were deemed to be a success.

Congratulatory Messages

M'CLURE STRAIT

September 16th, 1993

RADIO COMMUNICATIONS

I.D. IDENTIFICATION
RATE - TARIF
TYPE
L/L - CABLE TERRESTRE
AMT. - MONTANT
REV. - RECETTE

40-0031
4-86

GB CCGS LOUIS S. STLAURENT/CGBN NR13 DHRDO 161730UTC

AM OTTAWA
AMF OTTAWA
AMN OTTAWA
CM DARTMOUTH

LSL130
TODAY, THURSDAY SEPTEMBER 16, 1993 I HAVE THE PLEASURE TO REPORT THE SUCCESSFUL COMPLETION OF THE FIRST EVER EAST TO WEST TRANSIT OF M'CLURE STRAIT BY ANY SURFACE VESSEL. MEMORIES OF THE HARDSHIPS ENDURED BY M'CLURE AND THE CREW OF THE ILL-FATED INVESTIGATOR OF 1851-52 ARE AGAIN RECALLED WITH THE PASSAGE OF THE CCGS LOUIS S. ST-LAURENT.
A COMMEMORATIVE CAIRN HAS BEEN PLACED AT THE HEAD OF MERCY BAY IN POSITION LATITUDE 74 00 25 NORTH LONGITUDE 118 58 26 WEST TO HONOUR M'CLURE AND HIS CREW.

TODAY'S TRANSIT WOULD NOT HAVE BEEN POSSIBLE EXCEPT FOR THE DEDICATION OF ALL PREVIOUS ARCTIC EXPLORERS AND THE TEAM EFFORT INVOLVED IN THE MID-LIFE MODERNIZATION OF THE CCGS LOUIS S. ST-LAURENT.

REGARDS
CAPT. PHILIP GRANDY

SENT 161850 Z/bms/4m48

TRANSMITTED
SEP 16 1993
C.C.G.S. Louis S. St. Laurent
RADIO OFFICE

RADIO COMMUNICATIONS

I.D. IDENTIFICATION
RATE - TARIF
TYPE
L/L - CABLE TERRESTRE
AMT. - MONTANT
REV. - RECETTE

40-0031
4-86

Canadian Coast Guard | Garde côtière canadienne

Commissioner | Commissaire

Canada Building
344 Slater Street
Ottawa, Ontario
K1A 0N7

Édifice Canada
344, rue Slater
Ottawa (Ontario)
K1A 0N7

22 September 1993

Captain Phil Grandy
Commanding Officer
CCGS LOUIS S. ST. LAURENT
c-o P.O. Box 1000
Dartmouth, N.S.
B2Y 3Z8

Phil

Dear Captain Grandy:

I would like to extend my personal congratulations on the completion of your historic transit of M' Clure Strait.

Also, heartfelt congratulations from the Coast Guard for a job well done.

Yours sincerely,

John F. Thomas

SEP 23 1993

Canada

I.D. IDENTIFICATION
RATE - TARIF
TYPE
L/L - CABLE TERRESTRE
AMT. - MONTANT
REV. - RECETTE

40-0031
4-86

GB CCGS TERRY FOX NR1 NC 162046UTC

C/O CCGS LOUIS S ST-LAURENT

ON THE HISTORIC OCCASION OF THE FIRST PASSAGE THROUGH M'CLURE STRAIT, THE ENTIRE COMPLEMENT OF CCGS TERRY FOX OFFER THEIR CONGRATULATIONS TO CCGS LOUIS S ST-LAURENT. WE SHARE YOUR PRIDE AND WISH YOU SUCCESS IN THE COMPLETION OF THE LOUIS POST MODE-RNIZATION MAIDEN VOYAGE

C/O BARRY

RECD 162156UTC/GTS/4MH Z

RECEIVED
SEP 16 1993
C.C.G.S. Louis S. St. Laurent
RADIO OFFICE

I.D. IDENTIFICATION
RATE - TARIF
TYPE
L/L - CABLE TERRESTRE
AMT. - MONTANT
REV. - RECETTE

40-0031
4-86

GB ALAMEDA CA. 172300UTC

CCGS LOUIS S. STLAURENT VFA

SIR 172300UTC

CAPTAIN AND CREW CCGS LOUIS S. ST. LAURENT

CONGRATULATIONS ON YOUR MAGNIFICENT ACHIEVEMENT IN MCLURE STRAIT AND BEST WISHES FOR CONTINUING SUCCESS IN YOUR ICE STRENGTH TRIALS. SUCCESSES SUCH AS THIS DO NOT COME EASY AND STAND AS A TESTAMENT TO THE HARD WORK AND PERSEVERANCE OF THE FINE OFFICERS AND CREW OF YOUR GREAT SHIP. MAY THIS ACCOMPLISHMENT STAND AT THE HEAD OF A LONG LIST OF SUCH DEEDS IN THIS GREAT WHITE ARCTIC OCEAN. WARM REGARDS

OFFICERS AND CREW OF THE POLAR STAR
R.J. PARSONS CAPT USCG
RECD 170200UTC/GTS/VIA VFA

RECEIVED
SEP 17 1993
C.C.G.S. Louis S. St. Laurent
RADIO OFFICE

RADIO COMMUNICATIONS

I.D. IDENTIFICATION
RATE - TARIF
TYPE
L/L - CABLE TERRESTRE
AMT. - MONTANT
REV. - RECETTE

40-0031
4-86

GB DARTMOUTH NR 1 NC 171634UTC

CAPT. PHIL GRANDY C/O LOUIS S. ST-LAURENT

YOUR PROGRESS SINCE LEAVING DARTMOUTH HAS BEEN WATCHED VERY CLOSELY,
WITH GREAT ADMIRATION FROM ALL OF US HERE.
CONGRATULATIONS TO DATE AND BEST REGARDS.

K. C. CURREN

RECD 171708UTC/GTS/4MHZ

RADIO COMMUNICATIONS

I.D. IDENTIFICATION
RATE - TARIF
TYPE
L/L - CABLE TERRESTRE
AMT. - MONTANT
REV. - RECETTE

40-0031
4-86

GB VANCOUVER NR1 NC 17 2054UTC

CAPTAIN PHILIP GRANDY CCGS LOUIS S. ST LAURENT VIA VFA

I JUST RECEIVED WORD TODAY OF YOUR FANTASTIC VOYAGE. CONGRATULATIONS TO YOU, YOUR CREW AND THE SHIP FOR YOUR PASSAGE THROUGH THE M'CLURE STRAIT. BEST REGARDS

WILLIAM DANCER DIRECTOR GENERAL CANADIAN COAST GUARD WESTERN REGION

RECD FM VFA 172104UTC/GTS/4MHZ

RECEIVED
SEP 17 1993
C.C.G.S. Louis S. St. Laurent
RADIO OFFICE

RADIO COMMUNICATIONS

I.D. IDENTIFICATION
RATE - TARIF
TYPE
L/L - CABLE TERRESTRE
AMT. - MONTANT
REV. - RECETTE

40-0031
4-86

GB HENRY LARSEN NR7 NC 171850Z

COMMANDING OFFICER CCGS LOUIS S. STLAURENT/CGBN VIA VFA

RECEIVED
[illegible] 1993
C.C.G.S. Louis S. St. Laurent
RADIO OFFICE

CONGRATULATIONS ON YOUR TRANSIT OF M'CLURE STRAIT. YOU HAVE ACCOMPLISHED WHAT A MORE POWERFUL AND LARGER SHIP , NAMELY THE MANHATTAN IN COMPANY WITH CCGS JOHN A. MACDONALD FAILED TO CARRY-OUT. THIS WILL GO DOWN IN THE C.G. ANNALS. IN THE FITTEST TRADITION OF THE COAST GUARD, THIS IS A JOB WELL DONE PHIL. FROM HERE IN THE QUOTE EAST UNQUOTE TO THERE IN THE QUOTE WEST UNQUOTE GOOD SAILING TO YOU AND YOUR CREW. BEST WISHES STOP 171850Z

GOMES COMMANDING OFFICER.

RECD 172048UTC/GTS/4MHZ

RADIO COMMUNICATIONS

I.D. IDENTIFICATION
RATE - TARIF
TYPE
L/L - CABLE TERRESTRE
AMT. - MONTANT
REV. - RECETTE

40-0031
4-86

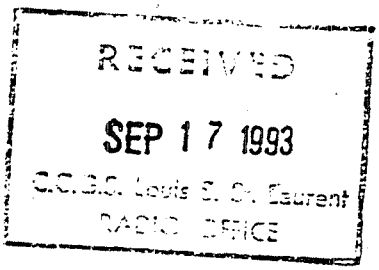
GB OTTAWA 172337UTC

COMMANDING OFFICER CCGS LOUIS S. STLAURENT VFA

A WELL DESERVED CONGRATULATIONS TO THE CAPTAIN AND CREW OF THE CCGS LOUIS S. STLAURENT ON THEIR HISTORIC TRANSIT OF M'CLURE STRAIT. MAY THEY BE RECORDED AS THE FIRST TO COMPLETE PARRY'S VOYAGE BY BREAKING INTO THE BEAUFORT SEA FROM THE EAST. REGARDS

DIRECTOR, SEARCH AND RESCUE

RECD 180044UTC/GTS/4MHZ



I.D. IDENTIFICATION
RATE - TARIF
TYPE
L/L - CABLE TERRESTRE
AMT. - MONTANT
REV. - RECETTE

40-0031
4-86

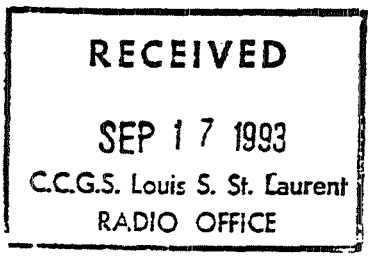
GB OTTAWA 172331Z

COMMANDING OFFICER CCGS LOUIS S. STLAURENT VFA

OPSNORD 122. SINCERE CONGRATULATIONS TO YOURSELF, THE OFFICERS AND CREW OF CCGS LOUIS S. ST.LAURENT FOR THE SUCCESSFUL VOYAGE THROUGH M'CLURE STRAIT. WE SHARE YOUR PRIDE AND HONOUR OF THIS SIGNIFIGANT EVENT AND APPRECIATE THE PLACING OF THE COMMEMORATIVE CAIRN DEDICATED TO M'CLURE AND HIS CREW. THANK YOU.
CAROL STEPHENSON DIRECTOR GENERAL COAST GUARD NORTHERN.

RECD 180028UTC/GTS/4MHZ

VIA VFA



RADIO COMMUNICATIONS

I.D. IDENTIFICATION
RATE - TARIF
TYPE
L/L - CABLE TERRESTRE
AMT. - MONTANT
REV. - RECETTE

40-0031
4-86

GB DARTMOUTH NR1 201200UTC

COMANDING OFFICER CCGS LOUIS S. ST.LAURENT VIA VFA

INFO AMF AMN

RE CMF 0456
CONGRATULATIONS ON COMPLETION OF HISTORIC TRANSIT OF M'CLURE STRAIT. AS BOTH THE FIRST PASSAGE FROM EAST TO WEST AND THE FIRST PASSAGE BY A CANADIAN VESSEL, THIS IS INDEED A LANDMARK. IT IS A FITTING REWARD FOR A CAPABLE ICEBREAKER AND A DESERVING CREW. BEST WISHES FOR THE REMAINDER OF YOUR VOYAGE. REGARDS

CMF DARTMOUTH

RECD 201211UTC/GTS/4MHZ

RADIO COMMUNICATIONS

I.D. IDENTIFICATION
RATE - TARIF
TYPE
L/L - CABLE TERRESTRE
AMT. - MONTANT
REV. - RECETTE

40-0031
4-86

GB OTTAWA NR1 211210Z

CAPTAIN PHILIP GRANDY C/O CCGS LOUIS S. ST.LAURENT VFA

RE: EAST/WEST TRANSIT M'CLURE STRAIT
CONGRATULATIONS TO YOU, YOUR OFFICERS AND CREW ON THE HISTORIC PASSAGE OF YOUR VESSEL EAST TO WEST THROUGH M'CLURE STRAIT. THE LONG AWAITED SUCCESSFUL OPERATION OF THE NEW IMPROVED VERSION OF OUR FLAGSHIP, LOUIS S. ST.LAURENT IS APPLAUDED BY ALL OF US AT HEADQUARTERS. WISHING HER MANY MORE YEARS OF HISTORIC FIRSTS.

PIERRE F. BOISVERT DIRECTOR GENERAL, FLEET SYSTEMS

211221UTC/GTS/4MHZ

Canadian Coast Guard | Garde côtière canadienne

Canada Building
344 Slater St., 7th Floor
Ottawa, Ontario
K1A 0N7

COPY

Your file / Votre référence
9172-L9-3-1
Our file / Notre référence

October 1, 1993

CCGS LOUIS S. ST. LAURENT
C/O Canadian Coast Guard Base Dartmouth
P.O. Box 1000
Dartmouth, N.S.
B2Y 3Z8

Attention: Capt. P. Grandy

Dear Capt. ~~Grandy~~ Phil:

Firstly, let me congratulate you and your crew on a splendid achievement. I also realize the monumental effort that you and your crew put in to get the ship ready for sailing in AUG 93.

This is now probably the most difficult phase as the ship must now be readied for the 'Transtec 94' voyage and there is a great deal of work, very little time and the ever present budget problems.

If myself or any of the personnel in Ottawa can assist you in your upcoming work, please do not hesitate to call on us.

The next formal phase of the project is the warranty and this like all the other aspects of this project will not be an easy one, however, the priority remains the ship and I can assure you that that is where our focus is.

Again, congratulations on your achievements and for silencing the skeptics once and for all.

Yours sincerely,

J. Redican
Project Manager
CCGS LOUIS S. ST. LAURENT Modernization
Major Crown Project
Fleet Systems, Canadian Coast Guard

RECEIVED
OCT 12 1993
C.C.G.S. Louis S. St. Laurent
SUPPLY DEPARTMENT

KRUPP MaK MaK

Krupp MaK Maschinenbau GmbH, Postfach 9009, 2459/ Kiel

CCGS Louis S. St. Laurent
Canadian Coast Guard Base Dartmouth
Foot of Parker Street
Dartmouth, N.S.
B2Y 3Z8

Fax 902-426-2586

Attn. Captain Phillip Grandy, Commanding Officer

Our ref:	Tel-No.	24159 Kiel
CS 1/Jensen/Mü	0431 3995-890	12.10.93
JE019.DOC		

Dear Sir:

From our representative, Reinold Arand, we have learned that the Louis S. St. Laurent has achieved another first! in her long history of achievements in the Arctic, when on August 16, 1993, she completed the first ever east to west transit of M'Clure Strait.

On behalf of Krupp MaK Maschinenbau GmbH and Krupp MaK Diesel Inc., we wish to extend our congratulations to you and to your crew. This success proves once more that the Louis S. St. Laurent is ready to take on future challenges in the north, and that she is well equipped to do so.

We wish you to know that Krupp MaK, as the propulsion supplier, is very proud to be part of this vessel. Please rest assured of our continuous support for the years to come.

Sincerely yours,

Krupp MaK Maschinenbau GmbH

Johannsen Jensen

Ein Unternehmen der Gruppe Krupp Hoesch Maschinenbau.

Fokkensteiner Straße 2, 24159 Kiel
Telefon: (0431) 3995-01, Telefax: (0431) 3995-157
Telex: 299877 mak d, Cables: mak kiel

Krupp MaK Maschinenbau GmbH
Sitz der Gesellschaft: Kiel
Handelsregister: Amtsgericht Kiel, Abt. B Nr. 604
Vorsitzender des Aufsichtsrats: Dr.-Ing. Gerd Weber
Geschäftsführung: Dr. rer. pol. Jens Hollunder, Sprecher
Heinrich Goldhoff, Dr.-Ing. Rolf-Dieter Haarscher
Dipl.-Ing. Günter Kues

FTL FLEET TECHNOLOGY LIMITED

12 October, 1993

Capt. Phil Grandy
Commanding Officer
CCGS LOUIS S. ST. LAURENT
Coast Guard Base
Dartmouth, Nova Scotia

Phil
Dear Capt. Grandy:

On behalf of myself and the staff at FTL, many of whom are intimately familiar with the LOUIS, may I congratulate you on your transit of McClure Strait and circumnavigation of Banks Island.

By all accounts heard here, the trip was a success and the vessel performed well.

Of course I was disappointed that we were not able to take part in the trials, but I am pleased that the vessel has lived up to expectations.

Perhaps it is time for some positive publicity!

Once more, congratulations!

Yours truly,

IAN F. GLEN, P. Eng.,
President

IFG/ks

COPY TO: P. Boisvert, Director General-Fleet Systems

311 Legget Drive, Kanata, Ontario K2K 1Z8 Telephone: (613) 592-2830 Facsimile: (613) 592-4950

Position of Land 93.9.16

Chart 7832. elevation 25' 74 00 25 N 118 58. 26 W

271 **Tides.** — Observations taken over a three-day period in 1953 indicated a spring rise of about 0.8 m (2.5 ft).

272 **Ice.** — The pack ice in this sector breaks up later than anywhere else along the north coast of Banks Island. In most years it never moves far from the coast.

273 **Coast.** — Between Cape Vesey Hamilton and Back Point, 11 miles WSW, there is an almost continuous beach of sand, gravel and pebbles along the shore. In most places within 20 to 40 m (66 to 131 feet) offshore the water is between 4 and 6 m (13 and 20 ft) deep and it deepens rapidly to seaward. On the landward side of the beach in most of this sector there is a low, level strip of ground backed by hills rising with varying degrees of steepness from about 90 m (295 ft) to about 240 m (787 ft) at Cape Vesey Hamilton. This shoreline receives the full force of the prevailing northerly and NW'erly winds and catches the ice which is driven along the coast from the NW. Observations indicate moderate variable winds do not loosen the ice along this part of the coast but it seems probable that an east wind would be most effective in driving the ice away. Apart from Cape Vesey Hamilton the only notable feature in this stretch is the braided stream that enters the strait midway along it.

274 **Mercy Bay** is where M'Clure of *Investigator* wintered in 1851 and 1852, having entered M'Clure Strait from the west, and where *Investigator* was abandoned. It is entered between **Back Point** and **Investigator Point** *(74°13'N., 119°05'W.)*, 5 miles west. Behind the beach on both sides of the bay the ground is usually rather muddy and slopes up gradually toward hills which rise near the shore to about 120 m (394 ft) on the east side and 210 m (689 ft) on the west side of the bay. Greater elevations occur farther inland, especially to the east. The most prominent features on the east side of the bay are **Gyrfalcon Bluff,** which rises to 190 m (623 ft) near its head and an extensive delta formed off the mouth of a river which enters the bay 3 miles south of Back Point.

275 **Providence Point,** at the mouth of a stream, is estimated to be about 9 m (30 ft) high and is not particularly prominent. A muddy shoal extends 0.5 mile off Providence Point and air photographs indicate the water deepens rapidly on its north and west sides.

276 *Investigator* anchored to the south of this shoal in what M'Clure called "a well protected bay" and which he said proved "a most safe and excellent harbour". Although air photographs do not indicate this anchorage as particularly well protected, it is worthy of note that *Investigator* does not appear to have been subjected to any ice pressure during two winters.

277 At the head of the bay, a narrow peninsula projecting north is reported to have an 8 m (26 ft) limestone cliff at its summit, which is about 30 m (98 ft) in elevation.

278 **Mottley Island,** about 2 miles north of the peninsula just described, is about 12 m (39 ft) high and rocky. A bare rock 3 m (10 ft) high lies half way between Mottley Island and the east side of the bay.

279 **Depths.** — The small bay which lies on the western side of the peninsula at the head of the bay shoals gradually toward its head; the smaller bay on its east side is deeper. North of this, however, the greater part of the east coast of Mercy Bay is bordered by shallow lagoons and drying mud flats. The water along the western side of Mercy Bay is fairly deep except for the shoal off Providence Point.

280 **Ice.** — The warm water from the rivers flowing into the head of Mercy Bay opens the SW portion in late June. The main part of the bay breaks up about the last week of July. In most years, the bay is never completely ice-free. This is partly due to the grounding of the larger and heavier floes within the bay thereby blocking the exit and also partly due to the fact that ice refills the bay with the high percentage of NW winds. Freeze-up is usually under way by mid September.

281 **Castel Bay** *(74°11'N., 119°34'W.)* is entered west of **Mahogany Point,** a low point formed by the outward fan of a brook. A bar, over which 3.4 m (11 ft) has been found at its western end, blocks the entrance. The depth and position of the deepest channel probably varies from year to year and it is possible that the current, which is quite strong on the east side of the bay, scours a new channel fairly rapidly after

Assessment Trials Report

R.P.BROWNE MARINE CONSULTANTS LIMITED
223-23rd Avenue N.E.
Calgary, Alberta
Canada T2E 1V8
Tel. & Fax. (403) 276-3832

24 September, 1993

To: Captain P.O.Grandy
Commanding Officer,
CCGS Louis S. St. Laurent

CCGS Louis St. Laurent Capability Assessment Trials
September 10 to 24, 1993

The ice trials team of Robin Browne, Merv Edgecombe and Ron Ritch joined the vessel at Resolute Bay, NWT, on Saturday, 10 September, 1993, three days prior to departure for ice trials on Tuesday 14 September. While in the Nares Strait the ship had suffered some damage in way of the port side heeling tanks. The damage occured during transit of an old ice regime, when the bow slid sideways while riding up on a large ice piece, resulting in a glancing blow on the port shoulder of the vessel. The damage was documented with measurements and photographs, and the information was used to determine placement of strain gauge instrumentation in the starboard side heeling tank. The port side damage, and some minor damage in the starboard heeling tank were repaired before the voyage began.

Additional CCG and Siemens trials personnel joined the vessel on Tuesday 14 September, at which time the vessel departed Resolute. Most of the trials instrumentation was installed and functioning by departure time. The instrumentation system was fully operational by 16 September.

The trials route took the vessel west to Tuktoyaktuk via McClure Strait (the first ever surface vessel transit East to West through McClure Strait), returning to Resolute via the Prince of Wales Strait (the first ever circumnavigation of Banks Island). During the voyage, the vessel encountered a wide range of ice regimes, and significantly, several heavy multi-year ice regimes. Recordings were made continuously of the vessel's position, speed and track, the ice conditions encountered, engine power and the hull stresses resulting from ice contact. Whilst at Tuktoyaktuk, additional strain gauges were fitted in the heeling tank, to the turn of the bilge near midships, and to the tank top and upper

deck. Gauges were also fitted on the steering gear rams to measure the loads on the rudder.

Preliminary results of the assessment of the performance of the new 'Louis' is summarsised as follows:

Icegoing Performance

The vessel made successful transits through all ice regimes encountered, including several non-optimum routings chosen specifically to test the vessel's capabilities. The vessel often worked, including ramming and turning operations, in vast multi-year floes with average thicknesses of three to four metres and extreme thicknesses in ridges and hummocks of twelve to fifteen metres. Ron Ritch has observed that the worst ice conditions encountered by the 'Louis' in these trials were comparable to those transitted by the Icebreaker Oden during her voyage to the North Pole in September 1991.

The vessel's bow was very effective in lifting smoothly and applying the vessel's weight to break thick old ice features, the large thrust available being applied in short, controlled, slow speed rams. The turning ability of the vessel in heavy ice conditions was impressive.

In addition to ice trials, a number of open water speed and power runs and bollard 'push' tests were recorded, documenting the ship's track and speed from the GPS on a common time base with the shaft power and rudder position.

The vessel did not encounter any level second year ice during the voyage. Consequently, it was not possible to carry out any of the classical level ice-breaking performance tests. It is recommended that such testing should be carried out during the Winter in the Gulf of St Lawrence or North Shore area.

Structural Performance

In the worst conditions of ice thickness, strength, and confinement, met during ramming operations on 16 September, stresses in several structural members in the heeling tanks exceeded yield values. The permanent set of the structure was observed and documented.

All later vessel operations were in lesser, although often still arduous conditions. Resulting stresses were often high, but rarely exceeded yield. A very clear trend in structural loading with ice thickness, strength and confinement is evident.

Although the predicted ice conditions for the 1994 voyage are not yet known, and the stresss data have received only preliminary analysis, it is clear that:
1. The vessel's structure in way of the heeling tanks is too weak in comparison with the available icegoing performance of the vessel during prudent operation.
2. The heeling tank structure, as is, would probably suffer severe damage during a voyage such as that planned for 1994.

It is considered, however, that the structure could be upgraded, without resort to dry docking, to a level sufficient for future intended operations of the vessel.

In addition to studying the heeling tank structure, the trials team has observed and recorded the structural performance several frames aft of the heeling tanks. It is considered that some structural work will probably be required in the turn of the bilge area immediately aft of the heeling tanks.

In respose to concerns regarding the strength of the main hull girder, stress measurements were made at the tank top and the upper deck levels. These measurments indicated low bending stresses during ramming.

Observation of the icebreaking process at the bow and the probable trajectory of broken ice blocks, suggests that ice loads on other areas of the hull could be significant from a structural point of view. Any opportunity to inspect the bottom structure of the vessel would be valuable in specifying locations for monitoring during the 1994 voyage.

The trials team wish to express their appreciation to Captain Grandy, his officers and crew, for their enthusiastic co-operation on the ice trials and the warmth of their hospitality. We hope to sail with you and the new Louis again.

Robin Browne
Merv Edgecombe
Ron Ritch