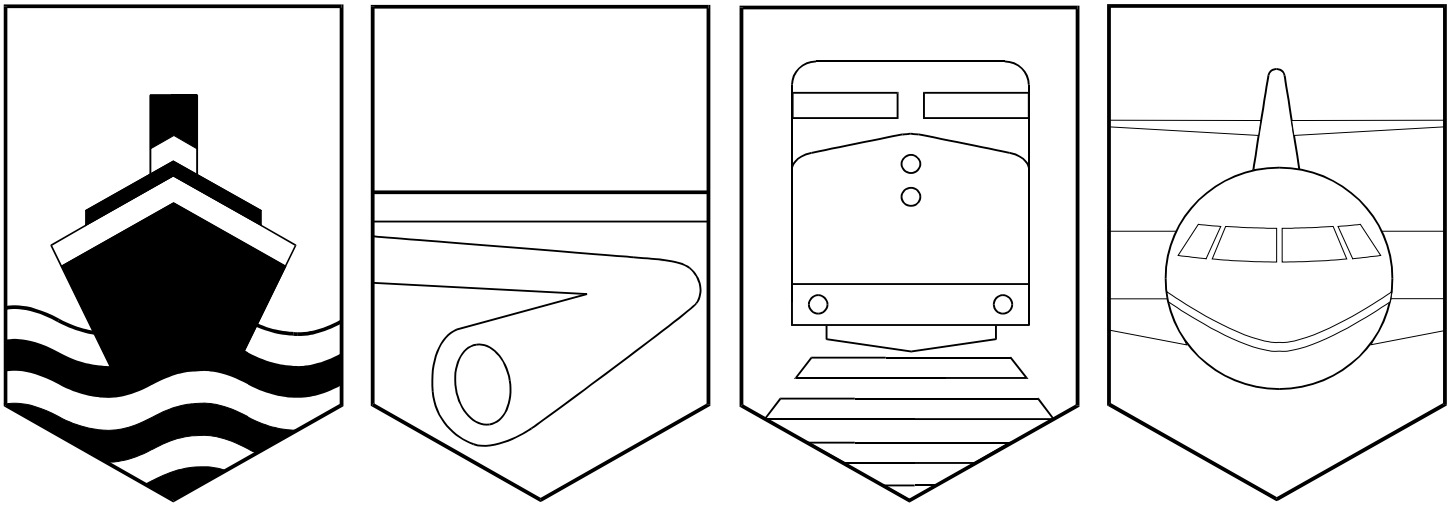
Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada



MARINE OCCURRENCE REPORT

FIRE ON BOARD

THE FISHING VESSEL "RALI II"
EAST OF CAPE BRETON ISLAND
07 JUNE 1994

REPORT NUMBER M94M0020

Canada

MANDATE OF THE TSB

The Canadian Transportation Accident Investigation and Safety Board Act provides the legal framework governing the TSB's activities. Basically, the TSB has a mandate to advance safety in the marine, pipeline, rail, and aviation modes of transportation by:

- conducting independent investigations and, if necessary, public inquiries into transportation occurrences in order to make findings as to their causes and contributing factors;
- reporting publicly on its investigations and public inquiries and on the related findings;
- identifying safety deficiencies as evidenced by transportation occurrences;
- making recommendations designed to eliminate or reduce any such safety deficiencies; and
- conducting special studies and special investigations on transportation safety matters.

It is not the function of the Board to assign fault or determine civil or criminal liability. However, the Board must not refrain from fully reporting on the causes and contributing factors merely because fault or liability might be inferred from the Board's findings.

INDEPENDENCE

To enable the public to have confidence in the transportation accident investigation process, it is essential that the investigating agency be, and be seen to be, independent and free from any conflicts of interest when it investigates accidents, identifies safety deficiencies, and makes safety recommendations. Independence is a key feature of the TSB. The Board reports to Parliament through the President of the Queen's Privy Council for Canada and is separate from other government agencies and departments. Its independence enables it to be fully objective in arriving at its conclusions and recommendations.

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Marine Occurrence Report

Fire on board

the Fishing Vessel "RALI II"

east of Cape Breton Island

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Synopsis

On 07 June 1994, as the fishing vessel "RALI II" was returning from the fishing grounds, a fire broke out in the engine-room. The flames were quickly suppressed by the gas smothering system. However, the resulting electrical power failure caused the vessel to begin to make sternway, which could not be stopped, thereby complicating any attempt at abandonment. There were no injuries as a result of this occurrence, but the engine-room sustained considerable damage.

The Board determined that the fire broke out when a component of the main fuel filters of the main engine failed and the engine-room personnel undertook to clean the filters. This component failure, combined with an improper work method, caused diesel fuel to splash on to the unprotected exhaust pipes. During the fire, the main engine emergency stop remote control and that of the propeller shaft clutch mechanism failed to work.

Ce rapport est également disponible en français.

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1.0 Factual Information

1.1 Particulars of the Vessel

	"RALI II"
Official Number	368328
Port of Registry	Cap-aux-Meules, Quebec
Flag	Canadian
Type	Stern trawler
Gross Tons[1]	488.81
Length	37 m
Draught	F[2]: 3.05 m A: 4.27 m
Built	1976, steel, Verreault Navigation Inc. Les Méchins, Quebec
Propulsion	One eight-cylinder Polar-Nohab diesel engine, controllable-pitch propeller
Owners	Madelipêche Inc. Cap-aux-Meules, Quebec
Complement	9

1.1.1 Description of the Vessel

The "RALI II" is a trawler used for groundfishing. She is the sister ship of the "NADINE" which sank in December 1990 causing the death of eight persons. As in the "NADINE" occurrence, the "RALI II" had begun making sternway at the time of possible abandonment.

1 Units of measurement in this report conform to International Maritime Organization (IMO) standards or, where there is no such standard, are expressed in the International System (SI) of units.

2 See Glossary for all abbreviations and acronyms.

3 All times are EDT (Coordinated Universal Time (UTC) minus four hours) unless otherwise stated.

1.2 History of the Voyage

At approximately 0030 eastern daylight time (EDT)[3] on 07 June 1994, the "RALI II" left the Misaine Bank fishing grounds east of Cape Breton Island to return to her home port at Cap-aux-Meules in the Îles-de-la-Madeleine. At or about 0140, a fire broke out in the engine-room when the vessel was in position 45°50'N, 058°07'W. The engine-room was immediately evacuated, the propeller pitch was set at zero, the engine speed was reduced to slow, the engine-room openings were closed, and the CO_2 gas smothering system was activated.

At the same time, a distress call (MAYDAY) was radioed to the Coast Guard Radio Station (CGRS) at Sydney, Nova Scotia. CGRS Stephenville, Newfoundland, replied immediately. Meanwhile, the crew prepared for possible abandonment.

An electrical power failure followed the activation of the gas smothering system. Shortly thereafter, the vessel began gradually to make sternway, dragging in her wake first one liferaft that had already been launched and then a second one that the crew had tried to launch under unfavourable conditions. The rafts were damaged, and the survival equipment they contained was lost.

The controls of the main engine were set at the lowest revolutions per minute (RPM). All attempts to disengage the propeller shaft or to stop the engine with the emergency stop button were unsuccessful. The remote controls to shut off the four diesel fuel tanks were activated, but the valve of the day tank did not close.

The "RALI II" continued making sternway for approximately one and a half hours. There were no injuries as a result of the fire, but the engine-room was damaged.

Three other vessels belonging to the same company were in the vicinity, the closest was only three or four miles away and the farthest, approximately two hours distant. They came to lend assistance. At 0500, the "FATIMA" took the damaged vessel in tow back to her home port, which they reached without incident at 1030, 08 June 1994.

1.3 Damage to the Vessel

The damage, caused mainly by the smoke and heat given off by the fire, was confined to the engine-room. The electrical wires running overhead in the engine-room over the source of the fire were severely damaged.

1.4 Certificates

1.4.1 Vessel's Certificates

The vessel had the certificates required under existing regulations.

1.4.2 Crew's Certificates

The master and the officer of the watch both held certificates appropriate to their positions and to the class of the vessel and to the type of voyage. The chief engineer did not have the minimum service required to obtain a certificate of competency as chief engineer of a motor-driven fishing vessel. However, at the owners' request, an exemption had been granted to the vessel by the Canadian Coast Guard (CCG).

1.4.3 Marine Emergency Duties (MED) Training

The certificated members of the crew had taken the MED courses required to obtain their certificates. Three other crew members had also received such training.

1.5 Personnel History

1.5.1 Master

The master held a fishing vessel master certificate in accordance with Canadian regulations. He had held the position of master on board the "RALI II" since November 1984. He had engaged in fishing since 1951.

1.5.2 Officers

The first mate held a fishing master certificate. He had been working on the "RALI II" for eight years.

The chief engineer had been working on the "RALI II" for five years, three of them as an engineer. This was his first trip as chief engineer. He had engaged in fishing for some ten years.

1.6 Weather Conditions Recorded by

At the time of the fire, the weather was clear with good visibility. The wind was from the south at less than 15 knots, the waves were approximately one metre high, and the air temperature was 5 $^{\circ}$ Celsius.

1.7 Radio Communications

1.7.1 Inter-Ship

At least five vessels responded to the distress call issued by the "RALI II" and relayed by the CGRS.

1.7.2 Vessel Traffic Services (VTS) or Coast Guard Radio Station (CGRS)

CGRS Stephenville answered the first distress call issued by the damaged vessel. The VTS Centre in Port-aux-Basques, Newfoundland, also responded.

1.8 Emergency Equipment

1.8.1 Life-saving Equipment

All the life-saving equipment readied for possible abandonment of the vessel worked properly, except that one of the liferafts inflated upside down. Both liferafts were damaged after launching when the vessel began to make sternway and dragged them in her wake.

1.8.2 Fire-fighting Equipment

The fire was suppressed quickly by the gas smothering system. No other fire-fighting equipment was used.

1.9 Search and Rescue

Three fishing vessels belonging to the same company were in the vicinity. They immediately went to the aid of the "RALI II". The crew did not have to abandon ship.

1.10 Response of the Crew

The method used by the engine-room personnel to clean the filters was not consistent with the manufacturer's directions or sound work practices.

No attempt was made to stop the main engine before the vessel began to make sternway, although this vessel, fitted with a controllable-pitch propeller, was known to make sternway following a power failure.

The liferafts were deployed without orders from the master.

1.11 Fuel Filters

A drop in the pressure of the fuel supply to the main engine led the engine-room personnel to try to change the main filters. They turned off the three-way valve to isolate one of the two filters (duplex type) and began to unscrew the cover without first lowering the internal pressure using the drain plug. As the diesel fuel was escaping with no drop in pressure, they tried to retighten the cover. As they were doing this, the centre post of the filter broke. The cover lifted off and diesel fuel sprayed on to the exhaust pipes of the main engine and caught fire.

Inspection of the failed component revealed that it had been welded previously. No one remembered when this repair had been made.

Inspection of the main filters revealed that the overflow valve on the unit that the engine-room personnel was trying to open was damaged and not operational. The ball held on its seat by a spring which prevents diesel fuel from flowing back toward the filter was missing. The seat was so worn that the ball slipped through (see Appendix A). The day tank is located above the level of the main filters.

1.12 Intensity of the Fire

The fire was fed by the main pipe bringing diesel fuel to the main engine. Within a few seconds of the fire breaking out, the intensity of the flames and the heat that they gave off were so great that the personnel was forced to evacuate the engine-room in a mad rush.

1.13 Controllable-pitch Propeller (see Appendix C)

Following the electrical power failure, the "RALI II" gradually began to make sternway.

Unlike a fixed-pitch propeller, a controllable-pitch (directional) propeller has a separate hub and blades that can turn to the required angle relative to the axis of rotation. Changing the angle of the blade changes the pitch so as to shift from "full ahead" to "full astern" without changing the direction of rotation of the engine and propeller.

At the base of each blade, there is a flange inserted into the propeller boss. The blade swivels around the centre of the flange on the boss. The pitch is changed by an axial motion of a control rod that passes through the hole in the hollow propeller shaft. The front end of this rod is connected to a piston inside the servocontrol cylinder, and the back end, to the pitch changing mechanism inside the hub of the propeller. This mechanism, consisting of a crosshead connected by a sliding shoe with integral crankpins to the base of each blade, converts the axial motion of the rod into a rotary motion of the propeller blades. To adjust the pitch forward or aft, hydraulic pressure is applied to one side or other of the piston by means of a distributing valve and the sealing ring on the shaft (commonly called an oil distribution box).

The surface area of the blade is not symmetrical around the axis of rotation, and the hydrodynamic forces exerted on the blade mean that hydraulic pressure must be maintained for the blade to retain a positive pitch for shifting to "full ahead". When all hydraulic pressure is lost, the hydrodynamic forces exerted on the blade force the blade to turn to a different angle in order to achieve a position of equilibrium.

The propeller of the "RALI II" is designed such that, when all hydraulic pressure is lost, the blades gradually turn to an angle equivalent to "full astern". This known blade design was dictated by the intended use of the vessel rather than by the mere need to move ahead or astern in the event of loss of hydraulic pressure. Apart from possible damage to the piping of the external hydraulic system resulting in loss ofpressure, the gradual passage to the aft pitch may be caused by a normal oil leak through the seal of the distribution box.

The hydraulic pressure of the propeller pitch system on the "RALI II" is maintained by electric pumps powered by the generators.

1.14 Remote Shut-off Controls

After evacuating the engine-room, the crew tried unsuccessfully to cut off the diesel fuel supply to the main engine by activating the remote shut-off valves on the fuel tanks. There are four separate fuel tanks: three of the valves worked properly, but the fourth one which was on the day tank, the tank supplying the main engine, did not work. This tank was found to be empty after the fire.

These valves, manufactured by Young & Cunningham Limited (see Appendices A and B), are fitted on several Canadian vessels, including passenger vessels. According to the manufacturer, the problem discovered on the "RALI II" has never been reported since this type of valve has been manufactured.

Tests conducted after the vessel returned to port showed that two valves out of four could not be operated

remotely if they were left in the full open position, but that they operated properly if they were closed half a turn after being opened all the way. It was also found that the collar that limits the opening of the valve had come loose.

1.15 Emergency Stop System

Shortly after the generator stopped, the vessel began to make sternway even though the propeller pitch control was set to neutral (0).

Attempts were then made to stop the main engine using the "emergency stop" push-button, but to no avail.

This control system is electric/pneumatic. The electricity comes from emergency batteries (24 volts). The batteries were in good condition, but the electrical wire to the engine control, running overhead in the engine-room, was found to have been severely damaged by the fire.

The system operated properly in tests conducted during the repairs and after the wire had been replaced.

1.16 Propeller Shaft Clutch System

The crew also attempted unsuccessfully to disengage the propeller shaft. This control system is also electric/pneumatic, but it operates on the 110-volt circuit.

If the electrical power supply is cut off, the clutch remains in its original position. As attempts to disengage the propeller shaft were made after the power failure occurred, the system, needless to say, was inoperative.

2.0 Analysis

2.1 Introduction

This fire clearly illustrates the importance of having well-trained crew members who are fully familiar with their vessel so that they can properly assess the situation confronting them when something unusual happens. The training and experience of the crew and the condition of the equipment played a major role in the outcome of this fire.

2.2 Crew Training

In training courses for engineers, it would perhaps be in order to stress how very important it is to follow the manufacturer's directions during maintenance operations.

Considering the history of the "NADINE" and the "RALI II", it could be expected that someone would have thought of stopping the main engine in case of an electrical power failure. After the sinking of the "NADINE", the "RALI II" was used to conduct tests to determine the effects of loss of hydraulic pressure on the propeller pitch.

Although the crew reacted well to the threat posed by the fire and each member knew exactly what his responsibilities were, the procedure for preparing to abandon ship had not been perfected as evidenced by the fact that the rafts were launched without awaiting the master's orders.

2.3 Fuel Filters

The fuel filters were installed on the front of the engine, near the turbocharger and the exhaust pipe. No splashguard was fitted to prevent diesel fuel from splashing on to the engine. The cover of the filter was loosened without first emptying the filter. The drop in the pressure of the fuel supply system was not due to dirty filters but to the failed overflow valve which allowed the diesel fuel to flow back freely to the day tank.

2.4 Controllable-pitch Propeller

There are alternatives that could prevent the propeller pitch from going to "full astern" when an electrical power failure occurs. There are pros and cons, however, to each of them, and only a thorough analysis of the possibilities can determine whether it is advantageous to implement them.

2.5 Quick-closing Valve

In order to enable the remote shut-off of the fuel tanks, they are fitted with quick-closing valves activated by steel cables. It was discovered that the collar that limits the opening of the defective valve had come loose. This impaired the operation of the tripping mechanism and, as the valve did not close, the fuel supply to the main engine was not cut off. For this reason, the main engine did not stop after the remote-controlled shut-off valves were activated.

2.6 Electric/Pneumatic Controls

Owing to a series of events, the propeller shaft clutch mechanism could not be disengaged and the main engine emergency stop did not work. The emergency stop system did not work because the electrical wires had been damaged by the fire. The propeller shaft clutch mechanism could not be disengaged because of the electrical power failure. These two systems had been checked during the vessel's annual inspection in the spring and had been found to be working properly at that time.

3.0 Conclusions

3.1 Findings

1. The engine-room personnel did not follow the ractices in cleaning the fuel filters.

2. The engine-room personnel was not aware that was damaged.

3. The fire was so intense that the engine-room had

4. The main engine was not stopped in the first

5. As a result of the electrical power failure and of pitch gradually passed to "full astern".

6. The system for disengaging the propeller shaft 0-volt AC power source, and no attempt was made to activate it before the

7. The main engine emergency stop system le, but the crew delayed too long in using it and, as a result, the electrical wire had me attempts were made to do so.

8. The remote-controlled shut-off valve of the day tank did not work because one of the components of the Quiclose valve had come loose, and this interfered with its operation.

9. The liferafts were launched under unfavourable conditions and without the master's orders.

10. The two liferafts were damaged, and their contents lost in the water, when they were dragged in the wake of the vessel as she made sternway.

3.2 Causes

The fire broke out when a component of the main fuel filters of the main engine failed and the engine-room personnel undertook to clean the filters. This component failure, combined with an improper work method, caused diesel fuel to splash on to the unprotected exhaust pipes. During the fire, the main engine emergency stop remote control and that of the propeller shaft clutch mechanism failed to work.

4.0 Safety Action

4.1 Action Taken

4.1.1 Quick-closing Valves

The locking collars of the fuel oil quick-closing valves were adjusted to limit the opening of the valves. The Canadian representative of the manufacturer also suggested impregnating the valve-retaining screws with a Locktite product No. 242 threadlocker. The ship's crew and shore maintenance people were made aware of the importance of this adjustment to prevent malfunction. On current and improved designs, the locking collar is no longer fitted.

The TSB apprised the Canadian Coast Guard (CCG) of the circumstances surrounding the malfunctioning of these valves. Further, given the importance of fuel shut-off valves and their widespread use on vessels, including passenger vessels, the TSB indicated the need to confirm the current operational reliability of such valves. Also, the TSB highlighted the need to establish procedures for maintenance and periodic functional checks of the fuel shut-off valves.

4.1.2 Emergency Shut-down

In addition to the existing main engine shut-down and electrical declutching mechanism, a direct air line with a dump valve has been installed in the wheel-house. This valve will declutch the main engine from the gear box by reducing the air pressure to the clutch to zero. This eliminates reliance on any electrical power supply to stop the vessel by de-activating the propeller shaft in an emergency situation.

The manufacturer has also stressed the importance of testing the operation of the various tripping mechanisms on a regular basis.

4.1.3 Fire and Boat Drills

During fire and boat drills, emergency procedures for fire in the engine-room and the relevant controls in the wheel-house are now emphasized to the officers and ship's crew.

4.1.4 Thermal Protection

The shield plate protecting the main engine exhaust pipe that had been removed during previous maintenance work, has been put back in place. A steel guard plate has been fitted to provide an additional safeguard near the fuel filters which have been replaced by new parts and relocated approximately two metres away from the main engine exhaust manifold and piping.

4.2 Safety Concern

4.2.1 Fires on Fishing Vessels

TSB records indicate that, between 1989 and 1993, there was, on average, 62 fires a year on board Canadian fishing vessels; over 50 per cent of these fires resulted in the loss of the vessel. During the same period, an average of 17 fires occurred in engine-rooms annually[4].

According to the Japanese classification society's (Nippon Kaiji Kyokai (NK)) *Study Committee on the Prevention of Engine Room Fires*[5], the most common hazard leading to engine-room fires is fuel spray from damaged pipes. This is supported by the data from Canadian occurrences involving fishing vessels. The major causes of engine-room fires reported in Canada include fuel or hydraulic fluid from broken pipes and fittings spraying on

hot engine parts; faulty electrical systems; and uninsulated exhausts in contact with flammable materials. Moreover, the 1987 CCG study into Fishing Vessel Safety[6] indicated that for the period from 1982 to 1986 inclusive, the major reported causes of vessel losses were fire and explosion, which accounted for 381 occurrences. The study cited improperly installed and maintained heaters; incorrect fuse ratings for electrical circuits; improperly secured and/or fractured fuel lines; oil or gas in bilges; and improperly installed propane systems as the major reason for the fires.

4 i.e. 17 occurrences in 1989, 19 in both 1990 and 1991, 17 in 1992 and 15 in 1993.

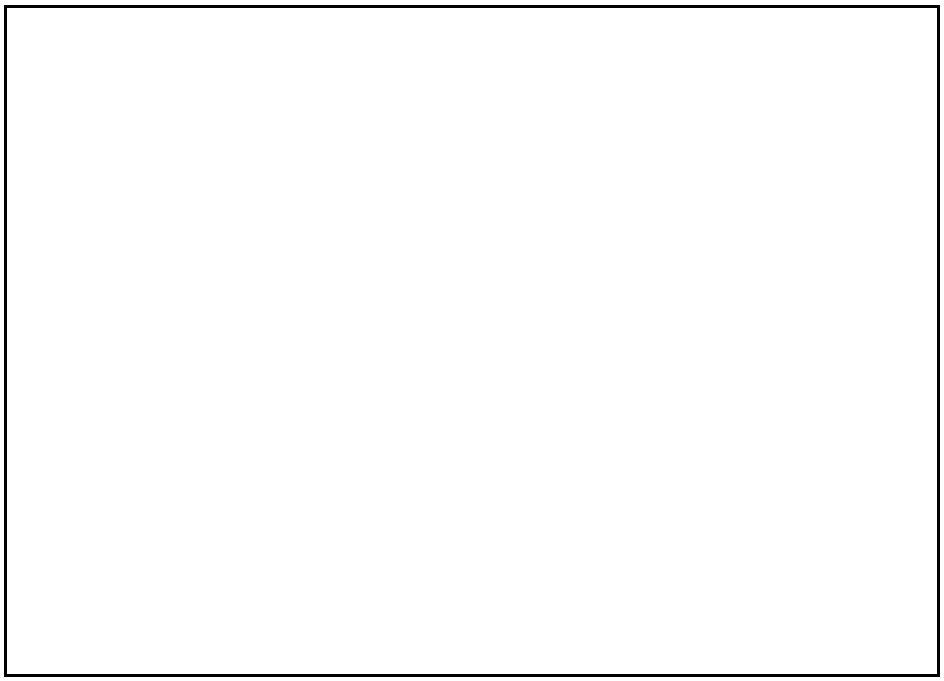
5 Engine room fire - Guidance to fire prevention 1994, by Masaru Iwamoto et al, ClassNK.

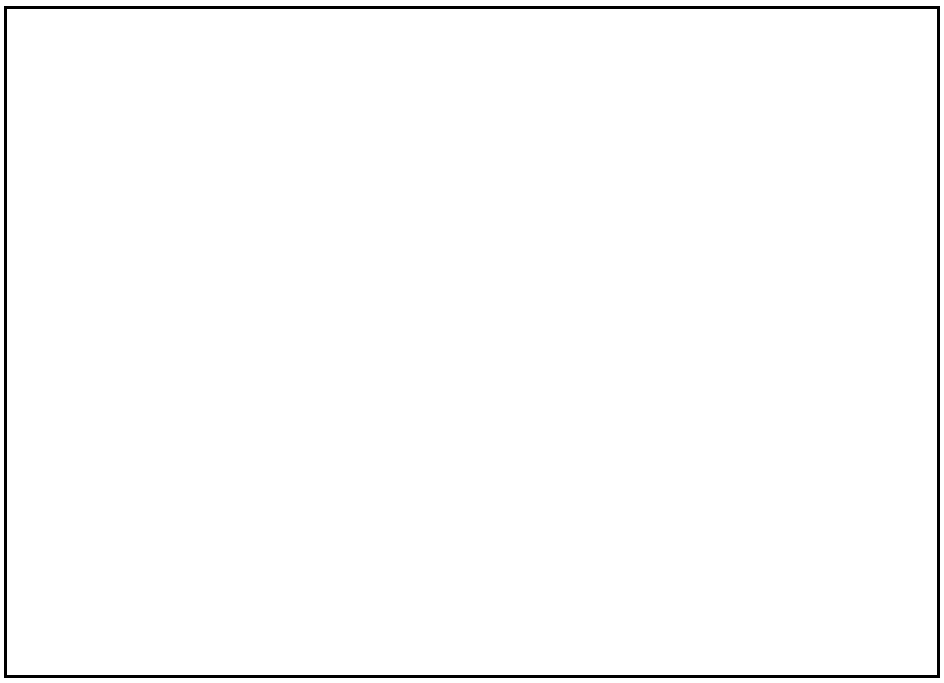
6 "A Coast Guard Study into Fishing Vessel Safety" - TP 8694

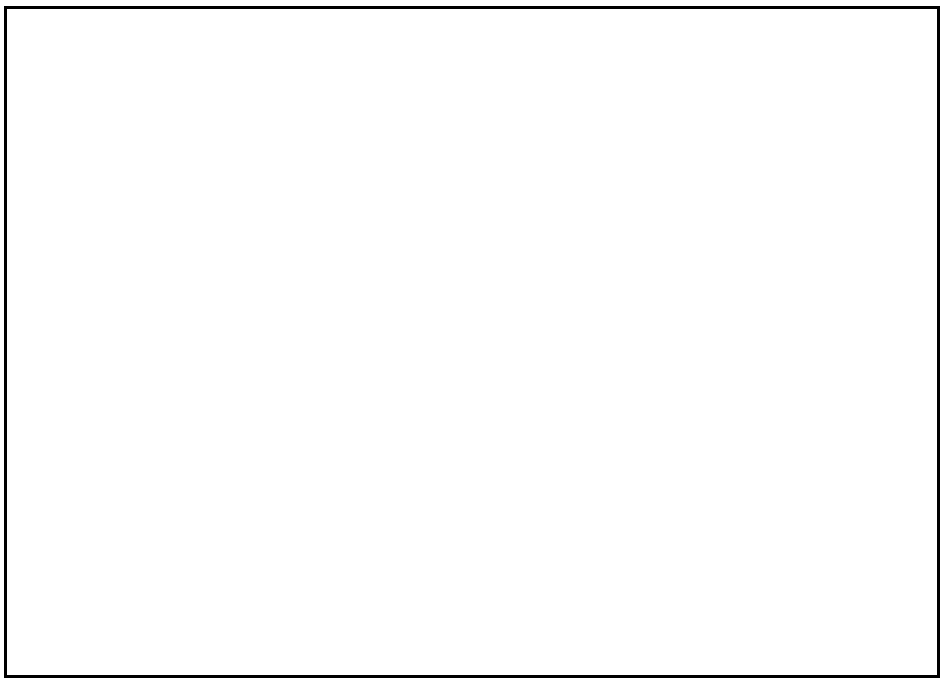
Notwithstanding that the CCG has long recognized the hazards associated with fire on board fishing vessels and has issued several Ship Safety Bulletins on the subject (in 1984, 1985, and 1989), there continues to be a significant number of fires in the engine-room of fishing vessels. Given the aforementioned Canadian statistics and as a result of recent fires on large fishing vessels (such as the "RALI II" and the 160 gross-ton fishing vessel "JUDITH SUZANNE" (TSB occurrence no. M93M0005)), the Board is concerned about the extent to which engine-room fires on board vessels continue to cause significant losses in the Canadian fishing fleet. Hence, the Board will assess these types of occurrences with a view to determining the need for further safety action.

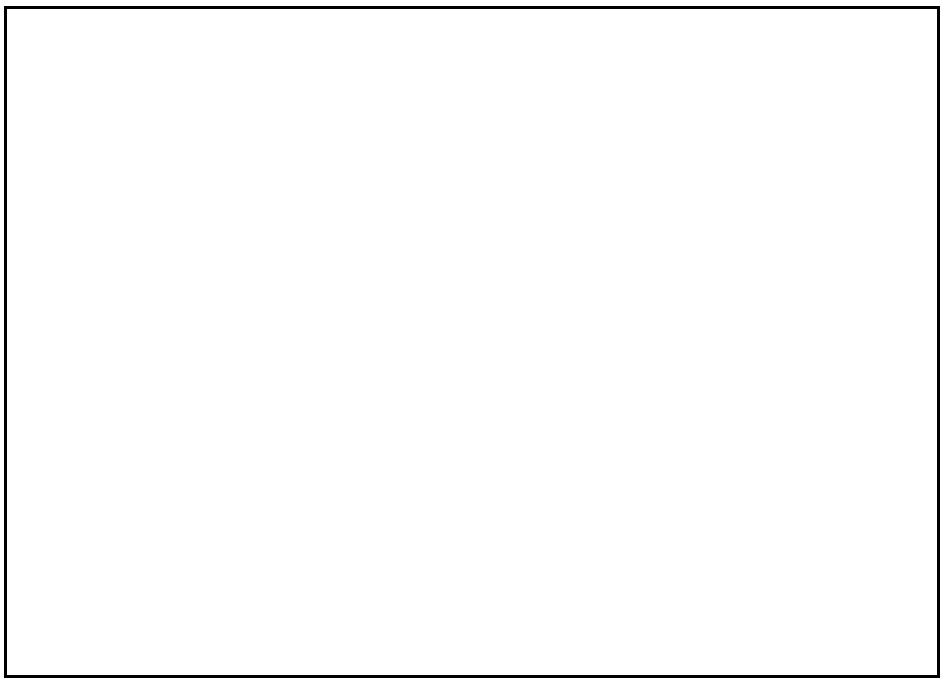
This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board, consisting of Chairperson John W. Stants, and members
Zita Brunet and Hugh MacNeil, authorized the release of this report on 5 June 1995.

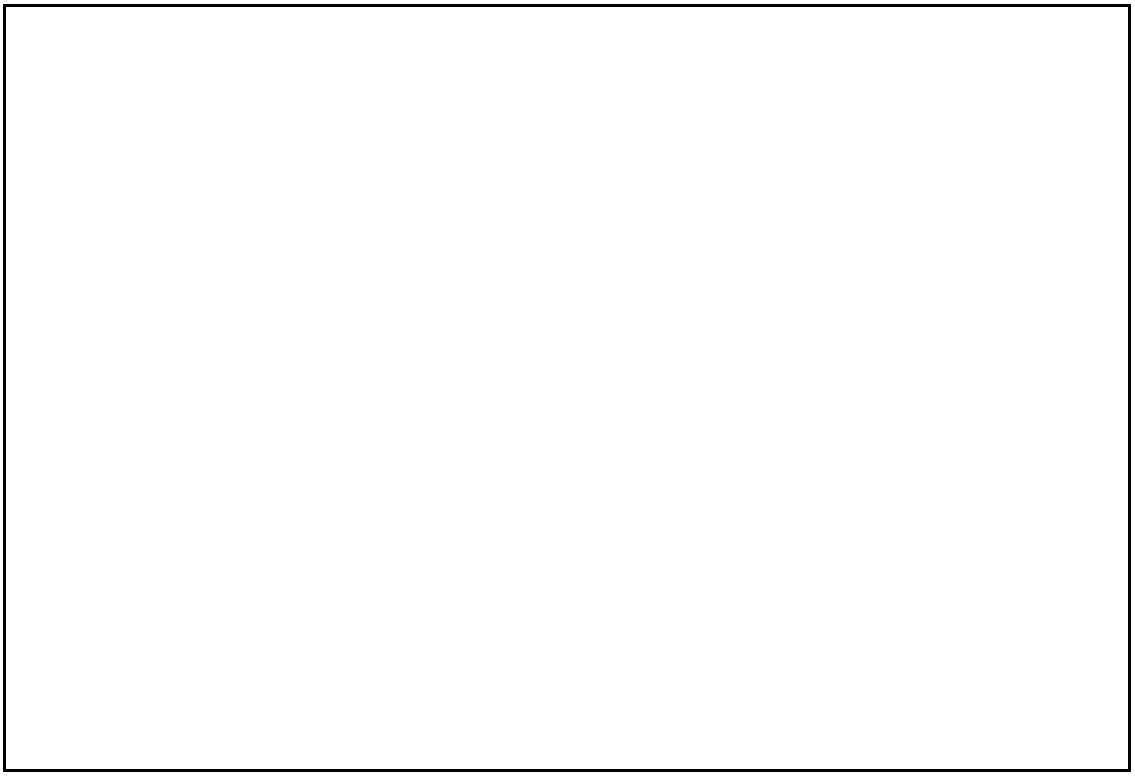
Appendix A - Photographs











Appendix B - "QUICLOSE" Valve

Appendix C - Sketch of the Controllable-Pitch Propeller

Appendix D - Glossary

A	aft
CCG	Canadian Coast Guard
CGRS	Coast Guard Radio Station
CO_2	carbon dioxyde
EDT	eastern daylight time
F	forward
IMO	International Maritime Organization
m	metre(s)
MAYDAY	Distress message
MED	Marine Emergency Duties
N	north
RPM	revolution(s) per minute
SI	International System (of units)
TSB	Transportation Safety Board of Canada
UTC	Coordinated Universal Time
VTS	Vessel Traffic Services
W	west
°	degree(s)
'	minute(s)

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