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An arrival too sudden: Duke Point crash

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Most of the time, BC Ferries arrive at their destinations in a graceful and dignified fashion. About ten times a year, they don't.

According to BC Ferries spokesperson Deborah Marshall, vessels in the fleet arrive at terminals 500 times a day, so it's not surprising that there is the occasional 'hard landing'. Hard landings on the biggest ferries are a matter for considerable concern. Sometimes they do enough damage to put the ferry, or the terminal, out of action for a while.

On December 20, at about 10:30am, *Coastal Inspiration*, one of the newest 'Super-C' ferries, crashed into the dock at an estimated five knots upon its arrival at Duke Point near Nanaimo. The terminal was seriously damaged and is now closed for an indefinite period, and the vessel put out of action until about January 20. Some 350 passengers and 100 vehicles were aboard. Thanks to a last-minute warning over the ship's PA system, only one crew member and one passenger were injured, and not seriously.

Marshall identified the cause of the crash as an 'electronic failure' on the bridge. The ship could not be slowed as it approached the berth; further investigation is promised.

According to reports, this happened at least once before. The *Coastal Renaissance* experienced a similar failure about two years ago. But on this occasion, the ship was apparently well back from the berth and the problem occurred as the skipper tried to slow the vessel to enter harbour. There was enough time for the ship's engineers to put backup systems into operation.

Super C- and C-Class Ships

The three 'Super-C' ferries *Coastal Renaissance*, *Coastal Inspiration* and *Coastal Celebration* were designed and built by the Flensburger Shipyard in Germany in 2007-2008 to performance specifications modeled on the 'C-Class' double-ended *Queens of Coquitlam*, *Cowichan*, *Oak Bay*, *Surrey* and *Alberni*, designed and built in BC in 1976-1981.

The original C-Class vessels have a capacity of 1500

passengers and 362 vehicles, and a maximum speed of 21 knots. At each end of the ship they have a single controllable-pitch propeller, 3.65 metres in diameter, and a wheelhouse with a full set of controls at each end. These BC-built C-Class vessels have two diesel engines driving each propeller through a gearbox.

Super-C Design Change

On June 30, 2005, the *Queen of Oak Bay* could not be stopped as it entered the terminal at Horseshoe Bay. It plowed into a marina, damaging a number of pleasure boats, eventually going aground on the mud. The cause of the incident was identified as an ill-fitting pin in the gearbox, so the vessel could not be put into reverse.

This incident occurred at about the same time as decisions were being made about the drive train for the new Super-C ferries. Seeking to avoid future gearbox problems, BC Ferries Services (BCFS) specified a constant-speed, non-reversible electric motor drive for the new ships, with electric power provided by four diesel generators.

On each Super-C driveshaft, there was to be a single controllable-pitch propeller, five metres in diameter, with four blades that could be adjusted to control the speed of the vessel. The blades could also be set trailing edge first, parallel to the ship's direction of travel, to minimize drag when the shaft was stationary and the vessel was driven from the opposite end. (See more in the 'Technical's' Box.)

Stopping a Super-C

A marine consulting firm, Glosthen Associates of Seattle, had been engaged by BCFS to provide due diligence over the design and build process. Their December 2007 report finally became available in response to a Freedom of Information (FOI) request last year.

From initial sea trials, the ship proved hard to stop. The report notes: 'The vessel exhibits...a crash stop head reach...greatly in excess of the C-Class and somewhat in excess of the Spirit Class. This performance...is basically the result of a design trade-off with speed and power, ie: the hull and propulsion system have been optimized for high speed

with low drag and low wake, (and low fuel consumption), resulting in a directionally stable vessel which takes longer to stop than as desired in the SOR (the Statement of Operational Requirements from BCFS). This trade-off between economics and maneuvering performance has been accepted by BCFS management and operating personnel.'

In other words, the hull form is slimmer and more easily driven than the original C-Class ferries, and with its greater weight (nearly double) it is harder to stop. Time must also be allowed to change the pitch on the aft propeller in Mode 1, or to deploy the forward propeller if in Mode 2 (see Box). It is obvious that if the propeller pitch does not respond to the controls, the ship will not slow at all.

Questioning the Constant Speed Drive

The Glostén report states: 'There was considerable discussion...regarding the use of constant-speed propulsion motors instead of variable-frequency drives. While the constant speed motors simplify the overall system and eliminate the high maintenance cycle converters, it results in the propulsion machinery running at full RPM all the time. The primary drawback is at the dock; where the nearly-feathered propeller is rotating at full RPM, any failure in pitch control could have severe consequences. This system has been fully reviewed and completely accepted, so while we do not suggest any physical changes, BCF should fully understand the pitch control reliability and failure modes, and consider including this topic in their vessel training program.'

It was reported that the Flensburger Shipyard and the American Bureau of Shipping, the responsible classification society, questioned the use of constant speed motors.

More Constant Speed Motor Problems

Originally, the operating concept saw both propellers, set at zero or near-zero pitch, running at full speed (Mode 2) while the ship was berthed, loading and unloading. This gave rise to many complaints from terminal users and residents of Departure Bay and Horseshoe Bay about noise ('just too loud') and vibration ('rattling windows, floors and glasses in cupboards, beds shaking') from the Super-C vessels.

These effects were reported in an April 2008 internal BCFS report, made available in response to an FOI request. It noted that vibration on the vessel's inshore bridge was 'intolerable' at zero pitch, and there was 'significant vibration' in passenger waiting areas of the terminal. Propeller wash caused 'extreme flow, flotsam, foam, and

sediment transport'; there were also reports of erosion of the Tsawwassen berth. (The tips of the five-metre propellers run very close to the surface, particularly when the ship is unloaded, and they travel at close to 75mph.)

To address these complaints, the recommendations of the report included improving the tie-up arrangements at the berths, stopping the propeller at the inshore end (effectively, reverting to Mode 1), and modifying the deflector wall that protected the marina at Horseshoe Bay.

Fuel Consumption Conundrum

It was also becoming evident that, far from using less fuel than the C-Class vessels, the new ships were using up to 30% more on the same routes. It seemed possible that some of this fuel consumption was associated with running both propellers when the ships were berthed.

Factors in Coastal Inspiration Crash

Are there clues here as to the cause of the December *Coastal Inspiration* crash? Passengers reported that the forward propeller did not seem to come into operation until after the vessel had hit the dock.

No doubt, a complete investigation will yield some answers, and identify electronic or mechanical components that may have failed. Reports of a previous and similar incident, involving the *Coastal Renaissance*, added to passenger concerns.

The constant speed drive strategy would seem to make correct, certain, and timely operation of propeller pitch controls on both ends of the vessel enormously critical. It would appear vital for every Super-C vessel to complete its changeover to Mode 2 well in advance of its approach to the berth.

Possibly, skippers minimize the use of Mode 2 because it is noisy and generates vibration, causes erosion, and uses more fuel. However, if Mode 2 does not start up when required, both stopping and steering the vessel may be, to say the least, very difficult. ☹

Until Duke Point re-opens, BC Ferries will operate the Duke Point-Tsawwassen Route via Departure Bay. The route will operate on the regular schedule for the Duke Point-Tsawwassen route, with sailings running between Departure Bay and Tsawwassen.

The Queen of Coquitlam, which has smaller clearance and carrying capacity, will sail the run while the Coastal Inspiration is repaired. The anticipated return date of the Coastal Inspiration is approximately January 20.