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Crash investigation finds electronic and human failures

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A Transportation Safety Board investigation of the December 20, 2011 crash of BC Ferries' *Coastal Inspiration* into the Duke Point berth found that the root cause was the failure of an isolating amplifier, a key piece of electronic equipment, which caused the bridge crew to lose control of the pitch of the forward propeller, so that it could not be used to slow the vessel as it approached the berth.

However, the investigation found that the bridge crew failed to undertake a routine test of the control system before the vessel approached the berth and also failed to interpret a light warning of the electronic failure.

Next, a back-up system on the bridge which enabled emergency control of the forward propeller was unfamiliar to the to the bridge team, so was not deployed. (There is another back-up that can be deployed from the engine room but by that time it was too late.)

The vessel collided with the berth at about 5 knots, damaging the ship and putting it out of action for about three weeks; damage to the berth took three months to repair. Probably thanks to a warning over the ship's PA system, injuries to passengers and crew were slight.

The At Sea Test

The procedures in the Vessel Safety Manual (VSM) provided that when the ship was a specific distance from the berth the docking mode, both propellers engaged, should be started up and tested. The bridge team, on this shift, didn't test whether the bow propeller could be controlled.

The Warning Light

If at any time the electrical power required by the motors exceeds that being produced by the generators, an electronic Generator Protection Module (GPM) is activated, as indicated momentarily by a 'Power Limited' light on the bridge control panel. The GPM responds to signals from isolating amplifiers. It was one of these that failed.

As a result, the 'power limited' light came on, and stayed on. However, bridge personnel had no way of determining what was meant by its continuous illumination. Unfortunately, it meant that the usual pitch controls for the forward propeller wouldn't work.

'Normal/Emergency' Switch

The bridge-level emergency pitch control, labelled the 'Normal/Emergency' switch, is customarily used by BC Ferries to solve another problem: stopping the shore-side propeller when in the berth in order to eliminate both vibration and erosion. Manufacturer Flensburger designed Super-Cs to have both propellers turning while berthed. However, the vibration, noise, and erosion resulting from the continuous revolution of the near-shore propeller were not tolerable to BC Ferries (or its neighbours). So, almost from the beginning of service the normal/emergency switch had been used daily for this workaround. When set to 'emergency' it enables the 'freeze' of

Coastal Inspiration

This vessel is one of three double-ended 'Super-C' class ferries delivered in 2008, and built by the Flensburger shipyards in Germany. They are used on routes that cross the Strait of Georgia between Tsawwassen and Duke Point (Nanaimo) or Swartz Bay. They each have a capacity of 402 vehicles and 1,604 passengers.

They have a bridge at each end. Each ship has four diesel generators (of which three are generally used) driving a constant speed electric motor (140 rpm) at each end driving a single large variable pitch propeller. There is also a rudder at each end.

The pitch of each propeller, and thus the speed of the ferry, is controlled from the bridge. When the ferry is in transit, it is normally driven by the aft propeller; the forward propeller is feathered to reduce drag, and the forward motor is switched off (this is termed Mode 1).

As the ferry approaches the berth, the forward motor is started, and the pitch of the forward propeller is set so it can be used as a brake. (When both motors are running, this is termed Mode 2.)

When the vessel is leaving the berth, control is transferred to the new forward bridge, and Mode 2 is employed until the ferry is safely on its way.

the propeller closest to the land.

During the accident, the bridge team did not know the switch's true function.

Commentary

The crash of the *Coastal Inspiration* was the result of a combination of electrical equipment failure, deficiencies in the training of the bridge crew, and possibly inadequacies in the design of bridge warning lights and controls, particularly in view of changes in their function to accommodate the 'freezing' of the shore-side propeller.

That lessons were learned from the crash and the effectiveness of revised procedures was shown by the safe conclusion to a similar incident involving the *Coastal Inspiration* on January 14, 2013, when the vessel approached the Duke Point berth in the middle of the afternoon. Testing of Mode 2, at the new distance from the berth, showed that the bow motor had failed to start. There was enough room to bring the ferry to a near stop in the middle of Departure Bay, aborting the landing.

The vessel was eventually berthed with the help of tugs, and repairs to the ship were completed the following morning. ✐

New Procedures

So what have BC Ferries done to prevent it happening again? According to the TSB report, BC Ferries has:

- increased the required distance from the berth for initiation and testing of Mode 2;
- connected the 'power limited' light to the vessel alarm system, so if it is lit for more than 15 seconds, an audible alarm sounds in the engine room;
- added 'critical failure response drills' to the training of bridge personnel;
- elaborated arrival procedures to include verification of systems prior to berthing by engine room personnel;
- included these procedures in simulation training for bridge personnel;
- increased the size of pitch gauges on the bridge; and
- revised the VSMs for Super-C ferries.

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