

MARINE OCCURRENCE REPORT

CAPSIZING

OF THE BARGE "SEASPAN 195"
WHILE BEING LOADED ALONGSIDE
THE SELF-UNLOADING BULK CARRIER "ATLANTIC SUPERIOR"
PLUMPER SOUND, BRITISH COLUMBIA
14 AUGUST 1995

REPORT NUMBER M95W0095

The Transportation Safety Board of Canada (TSB) investigated this occurrence for the purpose of advancing transportation safety. It is not the function of the Board to assign fault or determine civil or criminal liability.

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Summary

At 0410 on 14 August 1995, the barge "SEASPAN 195", attended by the tug "JACQUES CARTIER", capsized while loading gypsum rock alongside the self-unloader "ATLANTIC SUPERIOR". The barge was in the final stages of trimming when it suddenly heeled over to starboard and discharged all of its deck cargo. As the barge rolled, the port side of the cargo box hooked onto the port side of the main deck of the "ATLANTIC SUPERIOR".

The tug/barge mate, who was on the deck of the "ATLANTIC SUPERIOR" when the barge capsized, had both legs trapped and sustained multiple fractures.

Ce rapport est également disponible en français.

Other Factual Information

Particulars of the Vessels

Name	"ATLANTIC SUPERIOR"	"SEASPAN 195"
Port of Registry	Nassau, Bahamas	Vancouver, B.C.
Flag	Bahamian	Canadian
Official Number	383533	344689
Type	Self-unloading bulk carrier	Flat-deck aggregate barge
Gross Tonnage	23,955	1,623.91
Length	222.5 m Overall	63.4 m Overall
Cargo	Gypsum	Gypsum
Crew	35	Nil
Built	1982, Collingwood, Ont.	1970, North Vancouver, B.C.
Propulsion	Sulzer diesel, 11,095 BHP	Non-self-propelled
Owners	Canada Steamship Lines, Montreal, Que.	Seaspan International Ltd., North Vancouver, B.C.
Managers/Charterers	CSL International Inc., Beverly, Massachusetts, U.S.A.	Lafarge Construction Materials, Abbotsford, B.C.

The "ATLANTIC SUPERIOR" is a self-unloading bulk carrier with the bridge and engine-room located aft and 22 hatches forward giving access to five cargo holds. There are two conveyor belts located in tunnels underneath the cargo holds, and an unloading boom 79.55 m in length which pivots from aft. The vessel held current inspection certificates from her classification society and flag state.

The "SEASPAN 195" is of welded steel construction with a flat cargo deck sheathed in concrete with an asphalt overlay, raised foredeck and flat bottom plating. It has raked ends, a double-chine bilge, and is fitted with two towing skegs. The hull is subdivided by 2 longitudinal bulkheads and 4 transverse bulkheads into 15 watertight compartments. These void spaces are not used for ballast.

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, unless otherwise stated.

The barge has a permanent 2.13 m-high open-topped cargo box of steel construction with smooth inboard face and exterior steel stanchions. The box had a partially open panel near amidship on the port side.

The "SEASPAN 195", operating as an uncrewed barge and not carrying pollutants, was not subject to inspection by Transport Canada (TC) Marine Safety. Not employed on international voyages, it did not need an assigned load line, nor was it required to comply with any regulatory stability criteria. However, the "SEASPAN 195" does have both draught and load line marks.

The "SEASPAN 195" underwent a condition survey on 01 June 1995 prior to going on charter, at which time the barge was hauled out on dry-dock for inspection and repairs. All underdeck compartments were found to be intact and free of bilge water.

The "ATLANTIC SUPERIOR" arrived in Plumper Sound anchorage on the evening of 13 August 1995 with a cargo of gypsum and cement rock, loaded in Santa Rosalia, Mexico. About 14,500 metric tonnes (t) of gypsum rock was for discharge into barges at Plumper Sound. The remainder of the cargo was for discharge in Seattle, Washington, USA.

At 2000 on 13 August, a draught surveyor, representing the shipper, boarded the "ATLANTIC SUPERIOR" and carried out a draught survey. After due allowance for local seawater density, he determined the total cargo deadweight to be some 35,743 t.

Lafarge Construction Materials, the charterer of the "SEASPAN 195", has routinely utilised the self-unloading method to load cargo onto barges for the last six years at other locations, but only recently at Plumper Sound.

At about 0001 on 14 August, the "SEASPAN 195", under tow of the tug "JACQUES CARTIER", arrived at Plumper Sound from New Westminster, B.C., and awaited the departure of the barge "VANANDA" which was loading alongside the "ATLANTIC SUPERIOR".

At 0142, the "SEASPAN 195" was positioned starboard side alongside the port side of the "ATLANTIC SUPERIOR" between hatch Nos. 6 and 14. One headline was secured on the foredeck of the self-unloading bulk carrier and two tire fenders separated the vessels. The tug took up position near amidship on the port side of the barge with a forward tow-line attached to move the barge as required during the loading operation. The master of the tug was responsible for the loading, cargo distribution, and trim of the barge while alongside the self-unloader.

Before the loading operation began, the draught surveyor, the tug/barge mate (mate) and the duty officer (OOW) of the "ATLANTIC SUPERIOR" (acting on the chief officer's orders) held a meeting at which information was exchanged verbally. Loading arrangements made included:

- Communication was to be by portable radio. The radios were to be used by the mate, the OOW and the ship's deck-hand in charge of slewing the unloading boom, when required.
- An unloading rate of 1,500 t per hour was set, a rate about one third of the discharging gear's capacity.
- At least one minute was required to halt cargo delivery (i.e. to stop the conveyor belt). Because full

loading rates are not attained when short runs of cargo of one minute's duration are carried out, some 25 t of cargo would be delivered during the shutting down sequence.

The cargo surveyor and the mate carried out a joint survey on the "SEASPAN 195" at 0155. Freeboards were measured using a sounding tape which gave an initial mean freeboard of 13 ft 3½ in., with a related mean draught some 2¼ in. greater than the verified lightship figure of 3 ft 7 in., and led to the adoption of a constant deduction of some 48.6 t in all subsequent deadweight estimates. Once the initial mean freeboard was established, and after due allowance for the addition of a lightship constant and local seawater density, it was calculated that a loaded freeboard of 14 in. would equate to a cargo of between 3,500 and 3,600 t, which, reportedly, was the amount requested by the charterer.

The tug/barge master and mate were in near constant communication by radiotelephone; the mate used a portable radio. The tug/barge mate was also assisted by a deck-hand from the tug. During the loading operation, the mate was mostly on board the "ATLANTIC SUPERIOR" in the company of that vessel's OOW. The tug's deck-hand was on the barge assisting him to spot the boom to keep the barge in a near upright condition. Spotting the barge under the unloading boom was achieved by the tug moving the barge forward or aft as required. The vessel's crew assisted as necessary with the barge's mooring line, and by swinging the unloading boom inboard or outboard as instructed. The ship's electrician was on duty in the cargo control room.

Tidal streams flood north-west through Plumper Sound attaining maximum rates of two to three knots. The barge capsized about 1.7 hours after low water. There was a slight sea with light south-easterly winds. With the "ATLANTIC SUPERIOR" lying into the wind and current, the wind carried most of the dust cloud created by the cargo straight aft making it difficult for those on the tug to see the cargo peaks. Visibility was less affected on the self-unloader. Reportedly, the sprinklers on the unloading boom were in operation to suppress dust during the discharge of the cargo.

Loading of the "SEASPAN 195" commenced at 0206. The information supplied by those involved concerning the loading sequence and disposition of the deck cargo on the barge was contradictory. The exact loading sequence and precise disposition of the cargo is unknown.

In general, it is known that from three to six peaks of cargo were formed from aft to forward, after which the cargo loading was stopped at about 0330 for a draught survey on the barge. The port and starboard faces of the cargo peaks sloped to the upper edges of the cargo box, and

² The barge's deadweight scale is presented in imperial units.

some of the valleys between peaks were partially filled due to cargo running from the boom as the barge was moved. Reportedly, a peak at the mid-length of the barge was somewhat lower than the others because of the opening in the port side wall of the cargo box, and the deck cargo extended from about 4.5 m from the forward end of the barge, to about 7.5 m from the stern.

At about 0345, the surveyor and the mate determined that the mean freeboard was 26½ in. The surveyor calculated that about 3,259 t of cargo had been loaded, and he advised the mate that a balance of about 400 t was required to complete the requested total cargo load of 3,500/3,600 t. The rate of discharge to the barge until 0330 had been in the region of 3,200 metric tonnes/hour.

The barge was then repositioned and the cargo run for approximately one minute at the after starboard side to correct a slight list. The mate checked the after freeboard again, after which the cargo was run for about one minute at the port side aft. The after freeboard was rechecked, this time by the barge deck-hand while the mate boarded the "ATLANTIC SUPERIOR". The deck-hand reported the after freeboards to be 14 in. on the port side and 18 in. on the starboard side, and it was noted during and shortly after these latter runs that some cargo was spilling over the top of the sides of the cargo box.

The mate stood on the deck of the "ATLANTIC SUPERIOR" in line with the middle of the barge, with the OOW and the draught surveyor beside him. Although the boom was positioned to load just to starboard of the barge centre line on the after pile of deck cargo, there was still about 4.5 m clear deck space at the forward end of the barge and about 7.5 m aft. The mate gave the order to run the cargo for five minutes before rechecking the barge freeboards.

Shortly after loading resumed, the gypsum began to run in a steady stream from the top of the after piles and to spill over the sides of the cargo box. There was no communication between the tug\barge master and mate at this time. As the barge developed a noticeable starboard list, the tug's deck-hand scrambled, unharmed, from the barge to the tug.

At 0410, approximately three minutes after loading had resumed, the barge abruptly rolled over to starboard in a period subsequently estimated to have been about 10 seconds. As the barge began to list, the tug "JACQUES CARTIER" quickly backed away, breaking the tow-line. As the heel increased, the deck cargo suddenly self-discharged over the side. The resultant buoyant upthrust on the lightened and nearly capsized barge caused it to rise in the water, such that the port side wall of the cargo box became hooked on the main deck rails and gunwale on the port side of the "ATLANTIC SUPERIOR", trapping the mate's legs.

The unloading boom emergency stop was activated and cargo discharge stopped shortly afterward. The "ATLANTIC SUPERIOR" assumed a port list. Reportedly, 350 t of water ballast were required to return the vessel to the upright. Some cargo hatches could not be closed because the gantry crane rails were damaged.

The mate suffered compound fractures to both legs. He was subsequently freed and transported by a Canadian Coast Guard hovercraft to Vancouver, B.C., for hospitalization.

Personnel involved in the barge loading operation were properly certificated for their respective duties. The crew of the "ATLANTIC SUPERIOR" was experienced in loading and unloading operations.

The mate has been at sea since 1961 and had served on a Great Lakes self-unloader during the 1975-76 season. He had previous service in the towing industry and had loaded a barge while alongside a self-unloader once in 1990. He had joined Lafarge Construction Materials five days before the accident, and this was his first time loading from a self-unloader with this company.

The tug master had loaded alongside self-unloaders on four or five previous occasions.

The draught surveyor has been a surveyor since 1992. He is a master mariner with a Master's Degree in Maritime Management.

Lafarge Construction Materials outlines company policies for both office and ship personnel in its book *Master Standing Orders*. The book is divided into sections which cover such topics as Occupational Safety and Health, Workplace Hazardous Material Information System and the duties of the masters of company vessels.

The standing orders indicate that the responsibility for crew training lies with the master. The mate was not given formal training, but the loading operation was discussed by him and the tug master before loading commenced. The mate was given only approximate figures for the quantity of deck cargo to be loaded and the approximate freeboards at which to finish loading. The draught surveyor had a copy of the barge's deadweight scale for his calculations.

A section in the standing orders of the company's "Barge Loading Regulations" states in part:

All barges, unless otherwise authorised, be loaded to the following specifications:

1. **Minimum Freeboards: Forward - 24 inches. Aft - 12 inches**
2. **Minimum Rake - 12 inches
Maximum List - 4 inches**
3. **Load to be evenly distributed over the deck area and the cargo, even when peaked, must be trimmed to avoid shifting and/or loss of cargo.**

At the time of the occurrence, nothing in the company standing orders offered guidance to tug/barge crews on the loading or securing of barges while alongside self-unloaders. In addition, there was no provision for the training or re-familiarization of new employees in these aspects of the operation.

The "SEASPAN 195" was successfully removed from the side of the "ATLANTIC SUPERIOR" at 1930 on 24 August, and was subsequently righted. Examination showed no source of water leakage into the hull prior to the capsizing. Damage included the setting down and buckling of frames, bulkheads and side shell. The side of the cargo box had to be replaced, together with sections of main deck plating and sheathing.

The "ATLANTIC SUPERIOR" underwent temporary repairs before being granted an Interim Certificate from her classification society to depart Plumper Sound. Permanent repairs were later carried out in Seattle. Damage was confined to the port side of the vessel and included guardrails, air pipes, gantry crane rails and other fittings, along with side shell damage and associated buckling of side frames and stringers.

Between 2100 on 13 August and 0135 on 14 August, immediately before the "SEASPAN 195" commenced loading, the barge "VANANDA" successfully loaded some 5,564 t of cargo from the "ATLANTIC SUPERIOR".

On 10 May 1979, the "SEASPAN 195", while secured alongside the self-unloader "CHAVEZ" at anchor in Saanich Inlet, B.C., in a loaded condition, had capsized and become hung up on the side of the vessel in a similar manner to the present occurrence. As there was no witness to the first occurrence, the cause of the capsizing was not determined.

Subsequent to the most recent occurrence, the Marine Division of Larfarge Construction Materials reviewed its lightering procedures, and developed and instituted a "Lightering Procedure Check List" as part of its standing orders. The list enumerates the important procedures to be carried out during the loading operation and requires that a check list be completed to indicate the steps taken to ensure safe loading.

Analysis

Larfarge Construction Materials' standing orders call for a minimum mean freeboard of 18 in., which is also the barge's assigned load line. Based on the barge's verified deadweight scale, this freeboard equates to a total load (in salt water) of 3,551 t. Allowing for the local seawater density and the "constant" determined at the beginning of loading, this would have given a cargo load of 3,488 t.

It was reported that the calculations made at 0345 indicated that a mean freeboard of 14 in. on completion would correspond to the amount of cargo the charterer had requested to be loaded aboard the barge. This freeboard would have equated to a total deadweight of some 3,644 t, and a final cargo figure of 3,595 t.

Although the load line assigned to the "SEASPAN 195" did not apply at the time of the occurrence, at a freeboard of 14 in., the barge's draught exceeded her summer load line mark and that freeboard was less than the minimum specified in the charterer's "Barge Loading Regulations."

Although the weather was considered near optimum for the loading operation, the cargo dust suppression sprinkler system on the unloading boom was ineffective. Visibility on the tug and barge was severely restricted.

Throughout the loading operation, the tug/barge master and mate were in communication by radiotelephone; however, due to the dust clouds caused by the loading, the master could not always see the distribution/disposition of the cargo from his vantage point aboard the tug. Further, as the actual loading rate (+/- 3000 metric tonnes/hour) was double that which had been agreed upon before loading of the barge commenced, it was difficult for the master to retain effective control of the distribution and trimming of the

cargo. However, neither the master nor the mate requested that the loading rate be reduced.

Information obtained during the investigation indicates that, with the exception of areas where loading continued while the barge was being shifted, most of the valleys between cargo peaks were not properly trimmed. Some of the peaks were considered to be higher than the previous norm. Because of the unequal areas which were clear and unused at the forward and after ends of the deck, it is apparent that distribution of the cargo on the barge was not symmetrical.

After the draught survey, when the tug/barge deck-hand measured the after freeboards, the master, although reportedly concerned about the trim and amount of cargo yet to be loaded, did not intervene effectively to assist or advise the mate. Had some dialogue taken place between the master, the tug/barge mate and the ship's OOW, and a more precise loading sequence been formally agreed upon and maintained, the deck load could have been distributed so as to avert capsizing.

Because the information given by the witnesses concerning the location, height and number of peaks of deck cargo varied, the distribution and related centres of gravity of the peaks could not be determined. Consequently, precise analysis of the loaded barge's stability characteristics shortly before the capsizing is precluded. Further, the determination of the actual cargo deadweight may not have been accurate because freeboard measurements were taken instead of a reading of the inherently more precise draught marks.

However, it is known that the final runs of cargo were made to starboard on the sloping sides of the existing deck cargo peaks, and some cargo spilled over the top of the side wall of the cargo box. As the final loading continued, the resultant heeling effect caused the natural angle of repose of the sloping starboard sides of the existing cargo peaks to be exceeded, and initiated a sudden and accelerating athwartship shift of cargo.

The combined effects of the shift of the cargo on the sloping starboard sides of the peaks and the continued final runs of cargo caused a heeling moment which exceeded the barge's righting ability, which resulted in the sudden capsizing to starboard.

Findings

1. The freeboard measurements taken immediately before the capsizing show that the "SEASPAN 195" was loaded with approximately 3,540 t of deck cargo.
2. The deck cargo was not symmetrically distributed either transversely or longitudinally.
3. The deck cargo was loaded in peaks of various heights, some of which were at a greater height than that to which the cargo was normally loaded.
4. The final runs of cargo were made on the starboard side, the natural angle of repose of the sloping starboard sides of the existing cargo peaks was exceeded, some cargo shifted and spilled over the top of the side wall of the cargo box, and a sudden and accelerating athwartship shift of cargo occurred.

5. The cumulative heeling and trimming moments caused by the shift of cargo to starboard overcame the barge's righting ability and initiated its capsizing.
6. After the deck cargo self-discharged as the heel increased, the resultant buoyant upthrust on the lightened and nearly capsized barge caused it to rise in the water and become hooked by the port side wall of its cargo box on the main deck rails and gunwale on the port side of the "ATLANTIC SUPERIOR".
7. The tug/barge mate suffered severe injuries to his legs when trapped between the barge and the deck of the "ATLANTIC SUPERIOR".
8. Loading operation instructions were verbal; a written cargo plan, loading sequence, precise cargo deadweight and minimum finishing mean freeboards were not formalized before loading commenced.
9. The assigned load line giving a minimum summer freeboard of 18 in. was not applicable to the service on which the barge was employed.
10. The intended finishing mean freeboard of 14 in., as established from a draught survey carried out shortly before the capsizing, was less than the 18 in. minimum figure stipulated by the standing orders of the barge operators.
11. The dust suppression water sprinkler system on the unloading boom did not prevent the formation of a dust cloud which impaired the ability of those involved in loading to see the distribution of the deck cargo.
12. The adoption of a "constant" to account for an apparent increase in the verified lightship weight of the barge may have been the result of freeboard measurements being taken instead of a reading of the more precise draught marks.
13. At the time of the occurrence, nothing in the company standing orders offered guidance to tug/barge crews on the loading or securing of barges while alongside self-unloaders.

Causes and Contributing Factors

The "SEASPAN 195" capsized because unsymmetrical cargo distribution in conjunction with the heeling effects of the last runs of cargo initiated a shift of cargo on the sloping starboard sides of the existing deck cargo peaks, such that the combined heeling effects overcame the barge's righting ability.

Visibility of the deck cargo from the "JACQUES CARTIER" was obscured by the dust cloud generated during loading operations which resulted in the creation of some unusually high peaks and contributed to the reported unsymmetrical distribution of the deck cargo.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board, consisting of Chairperson Benoît Bouchard, and members Maurice Harquail, Charles Simpson and W.A. Tadros, authorized the release of this report on 25 February 1998.