

National Transportation Safety Board

M/V Lady D Capsizing
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USCG Significant History of Small Passenger Vessel
Stability Regulations

Naval Architecture Report

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1 **Significant Events in the Regulatory Background of Small passenger Vessel**
2 **Stability.**

3 According to documents published by the Coast Guard and other sources, before
4 1951, regulatory restrictions designed to ensure that a vessel in commercial service
5 operated in a manner that promoted safety of life at sea were limited to large passenger
6 vessels over 65 feet in length and/or carrying more than 150 passengers. On September 1,
7 1951, the small commercial fishing boat M/V *Pelican*, carrying 64 people, capsized in
8 heavy seas about 1 mile from Montauk Point on Long Island, New York. A 1952 lessons-
9 learned article¹ published by the Coast Guard stated that the *Pelican* was a boat “of
10 dimensions and type [that] could not ordinarily be expected to carry more than about 30
11 persons with safety on coast-wise waters....” Because of the vessel’s overloaded
12 condition, the sea state, and the failure of the boat’s occupants to don lifejackets, 45
13 people died as a result of this accident.

14 The *Pelican* accident prompted the U.S. Congress to enact law the Act of May 10,
15 1956 (Public Law 519), which required the U.S. Coast Guard to write regulations for the
16 inspection and certification of certain vessels carrying more than six passengers.

- 17 • The USCG Marine Safety Council held Public Hearings on October 16, 1956, to
18 receive comments on proposed regulations that would comprise the a new 46 CFR
19 Subchapter “T”, entitled “Small Passenger Vessels (not more than 65 feet in
20 length). Giving force and effect to Act of May 10, 1956.
- 21 • Proposed stability regulations to apply to all passenger vessels carrying more than
22 49 but not more than 150 passengers. The regulations were to include, among
23 other specifications, stability test procedures, stability standards², a limitation on
24 the number of people that a vessel could carry to prevent overloading and a
25 stability letter containing instructions for the master to follow to prevent the boat
26 from capsizing.

¹ “Death Struck 45 Times,” *Proceedings of the Marine Safety Council, Volume 9, Number 3*, March 1952, page 74.

² Stability is the tendency of a vessel to remain upright or the ability to return to the normal upright position when heeled by the action of weight movements, waves, wind, etc.

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- For vessels greater than 65 feet in length or carrying more than 150 passengers, the regulations found in 46 CFR Subchapter “H” (Large Passenger Vessels) still applied.

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- The proposed regulations would also apply to all passenger vessels whose stability was questioned by the OCMI.

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- Final rules, 46 CFR Subchapter “T”, were published on October 5, 1957, and applied to all US passenger vessels carrying more than 6 passengers. The rules covered among other topics:

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- Inspection and Certification,

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- Construction and Arrangement,

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- Watertight Subdivision, and

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- Stability.

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- The rules gave the OCMI discretion to accept alternatives, equivalents or departures from the new standards when it could be shown that special circumstances warrant such actions, especially for existing vessels.

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- Existing vessels had to meet the new requirements insofar as was deemed reasonable and practical by the OCMI.

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- With respects to subdivision and stability, departure from these requirements may be permitted, “if, in the judgment of the OCMI, the vessel is of a type and structure which experience has demonstrated is safe for the proposed service.”

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- The new rules required vessels carrying more than 49 but not more than 150 passengers to:

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- Submit plans showing lines, curves of form and tank capacities tables,

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- Be subject to a stability test (inclining experiment) according to specific prescribed procedures,

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- Meet specific net metacentric heights (GM)³ at any operating condition based on calculated weather and passenger heel criteria

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³ GM is the distance from a vessel’s center of buoyancy (metacenter) to its center of gravity. If the center of gravity is below the metacenter, the vessel is initially stable. GM is the measure of a vessel’s initial stability or the ability to resist heel from the upright position. In general terms the larger the GM, measured in feet, the more stable the vessel.

- 1 ○ One compartment damaged stability.
- 2 • Existing SPV which were brought under inspection for the first time by the Act of
3 May 10, 1956, were permitted to meet a simplified stability test (SST) specified in
4 a Navigation Vessel Inspection Circular (NVIC) developed to supplement the 46
5 CFR Subchapter “T” regulations for the large number of existing vessels that now
6 had to meet a stability and reserve buoyancy standard.
- 7 • The SST sacrificed precision that would normally come from an inclining
8 experiment compensated by a conservative procedure that did not require
9 knowledge of the vessel’s form or properties and or the need to hire a naval
10 architect. The SST was a pass/fail proof test of the vessel’s stability performance
11 and the skill of the designer.
- 12 • On February 18, 1960, the USCG proposed revising 46 CFR Part 179 (Stability)
13 in its entirety to allow a simple method for determining the stability of SPV which
14 carried more than 49 but not more than 150 passengers using a method similar to
15 that used on existing SPV. No special plans were required, nor the services of a
16 naval architect.
 - 17 ○ The SST method applied to mono-hull designs and for the purposes of
18 determining the number of allowed persons, the weight per passenger
19 were 160 pounds except that on protected waters, a weight per passenger
20 of 140 pounds may be used when the passengers consisted of men,
21 women, and children
 - 22 ○ Because of the USCG’s limited experience with the analysis of righting
23 arm characteristics, the stability standards for passenger vessels of unusual
24 design (multi-hull type vessels such as pontoons, catamarans, and
25 trimarans, SWATH, sailing vessels, hard chine vessels, etc.) were
26 relegated to 46 CFR Subchapter “H” with a precautionary regulation until
27 more definitive standards for vessels of unusual design could be
28 developed.⁴
- 29 • These proposed rules became final on September 29, 1960.

⁴ FR dated February 18, 1960, page 148, paragraph 82, USCG NPRM, “Navigation and Vessel Inspection Regulations.”

- 1 ○ For SPV carrying less than 50 passengers, unless the OCMI questioned the
2 stability, there were no required stability standards.
- 3 ○ The simplified method (SST) for determining the stability of a SPV could
4 also be used for vessels where the OCMI questioned their stability. (i.e.
5 SPVs carrying more than 6 but less than 50 passengers).
- 6 ○ Owners were still allowed to use in lieu of the SST method, the alternate
7 procedures of carrying out an inclining experiment and meeting the
8 minimum GM passenger and weather heeling moment criteria found in 46
9 CFR Subchapter “H”. This required the services of a naval architect and
10 vessel plan submission but offered the possibility that, because of the
11 conservativeness of the SST, rigorous stability calculations would show
12 the vessel could carry more load (passengers).
- 13 • There now existed three categories of small passenger vessels w.r.t. stability:
- 14 ○ Vessels under 65 feet in length carrying less than 50 passengers where the
15 OCMI had the maximum latitude in accepting the adequacy of the vessel
16 based on his knowledge and experience. These vessels were typically
17 smaller, operated in less severe service and were not required to meet a
18 subdivision standard.
- 19 ○ Vessels under 65 feet in length carrying 50-150 passengers had to meet a
20 one compartment standard of subdivision and the OCMI did not have the
21 discretion of accepting the vessel’s stability based on his experience.
22 Often an inclining experiment would be performed because the vessel
23 prosperities derived from an inclining experiment (lightship displacement
24 and vertical center of gravity) were needed for calculations of subdivision
25 and damaged stability in addition to intact stability.
- 26 ○ Vessels under 65 feet in length carrying more than 150 passengers were
27 usually larger vessels and need to meet more complex calculations for
28 stability (intact and damaged) and subdivision. These vessel basically had
29 to meeting the standards for large passenger vessels (46 CFR Subchapter
30 “H”)

1 A USCG study⁵ completed in the mid 80's found that the SST procedure for
2 vessels on protected or partially protected routes provided a higher level of safety that
3 when evaluated for the alternate stability criteria of GM or righting energy.

4 Prior to the regulatory changes made to 46 CFR Subchapter "T" in 1996, there
5 was no mandatory stability "standard" for "T" boats carrying less than 50 passengers.
6 Determination of a vessel's adequacy for a specific route was left to the discretion of the
7 OCMI. No stability test of the vessel was required unless "questioned by the OCMI."⁶
8 For mono-hull vessels the SST found in 46 CFR171.030⁷ was the required test when the
9 stability of a vessel was questioned by the OCMI. The test had two independent
10 components; passenger heel and wind heel, and determined if a vessel, as built and
11 operated, had a minimum level of stability and reserve buoyancy. A passenger heeling
12 moment was calculated based on the beam of the vessel and the number of passengers
13 carried. A wind heeling moment was calculated based on the projected lateral surface of
14 the vessel exposed to wind pressure. A SST on the vessel was conducted by physically
15 applying the greater calculated heeling moment to the vessel and measuring the vessel's
16 loss in freeboard. The simplified proof test standard allowed for only one-half of the
17 freeboard (or 14° which was less) to be submerged during the test. If the vessel failed the
18 test the owner needed to reduce the heeling moment by either carrying fewer passengers,
19 ballasting the vessel, or reducing the vessel's wind profile area, or combinations of these
20 variables. The SST ultimately was part of the input into the determination of the occupant
21 capacity of the vessel as listed on the vessel's Certificate of Inspection.

22 U.S. Coast Guard guidance to OCMI's on pontoon (passenger vessel) simplified
23 stability test (PSST) was originally found in the Merchant Marine Safety Manual,
24 Volume IV. The late 1960s policy outlined the recommended procedures for a stability
25 proof test for pontoon-type small passenger vessels under 65 feet in length with
26 operations restricted to protected waters. One departure from the SST for mono-hull

⁵ Evaluation of Small Passenger Vessel Stability Test Procedures, contract DTCG 23-83-C-20089, September 1984, Arctec, Incorporated.

⁶ 46CFR171.030(a)(2), circa October 1, 1995.

⁷ A "Small Passenger Vessel Stability Test Procedure" field guide (CG-4006, sheets 1-7) was eventually developed to assist the owner/USCG in calculating the heeling moments for the test procedure for mono-hull vessels.

1 designs, the stability guidance for pontoon vessels did not require a separate test for wind
2 heel⁸. A passenger heel proof test was intended to simulate a full load of passengers, crew
3 and other weights initially centered on the vessel and then moved to the extreme outboard
4 transverse and longitudinal edges of the vessel. The vessel needed to pass a deck edge
5 immersion test for longitudinal weight movements and a reserve buoyancy test⁹ when the
6 weight was moved transversely. The maximum passenger load that satisfied both tests set
7 the passenger carrying capacity of the pontoon vessel, if not limited by other 46 CFR
8 Subchapter "T" criteria such as fixed seating, rail length or deck area. The USCG did not
9 have a small PSST procedure field guide as was developed for mono-hull vessels and the
10 mono-hull vessel field guide calculations and testing procedures were not applicable to
11 pontoon vessel designs.

12 If requested by the OCMI, the Marine Safety Center would determine if stability
13 for a pontoon vessel could be evaluated with a proof test or if stability must be evaluated
14 using the stability standards found in 46 CFR Subchapter "S" using an inclining
15 experiment and calculations of GM and righting arms¹⁰.

16 On January 30, 1989, the U.S. Coast Guard proposed requiring all SPVs carrying
17 more than 6 passengers, except those vessels that were required to undergo an inclining
18 experiment, to pass aSST. The NPRM also proposed incorporating policy in the U.S.
19 Coast Guard Marine Safety Manual into regulations, which provided a simplified means
20 of testing the intact stability of pontoon vessels of not more than 65 feet in length, not
21 carrying more than 150 passengers, and operating only in protected waters. The form of
22 this PSST proposed in 46 CFR178.340 was substantially taken from the current version
23 found in the Marine Safety Manual. The PSST, in proposed rules, was revised on
24 September 24, 1990, to limit it to small passenger vessels with two pontoons and referred
25 vessels with more than two pontoons to be evaluated by the Marine Safety Center for a

⁸ An exception to the wind heel proof test was made for pontoon vessels because the early designs of these vessels did not carry canopies or deckhouses.

⁹ The remaining exposed cross sectional area of the pontoon must be equal to or greater than the cross sectional area submerged due to the passenger weight load shift

¹⁰ A righting arm is the perpendicular distance between the lines of force of gravity and buoyancy when a vessel is heeled. It represents a measure of the vessel's ability to right itself over a range of heel angles.

- 1 stability. This proposed rule of January 30, 1989, and reissued in NPRM form on January
- 2 13, 1994, was made final on January 10, 1996.