On Developing a Rational and User-friendly Approach to Fishing Vessel Stability and Operational Guidance

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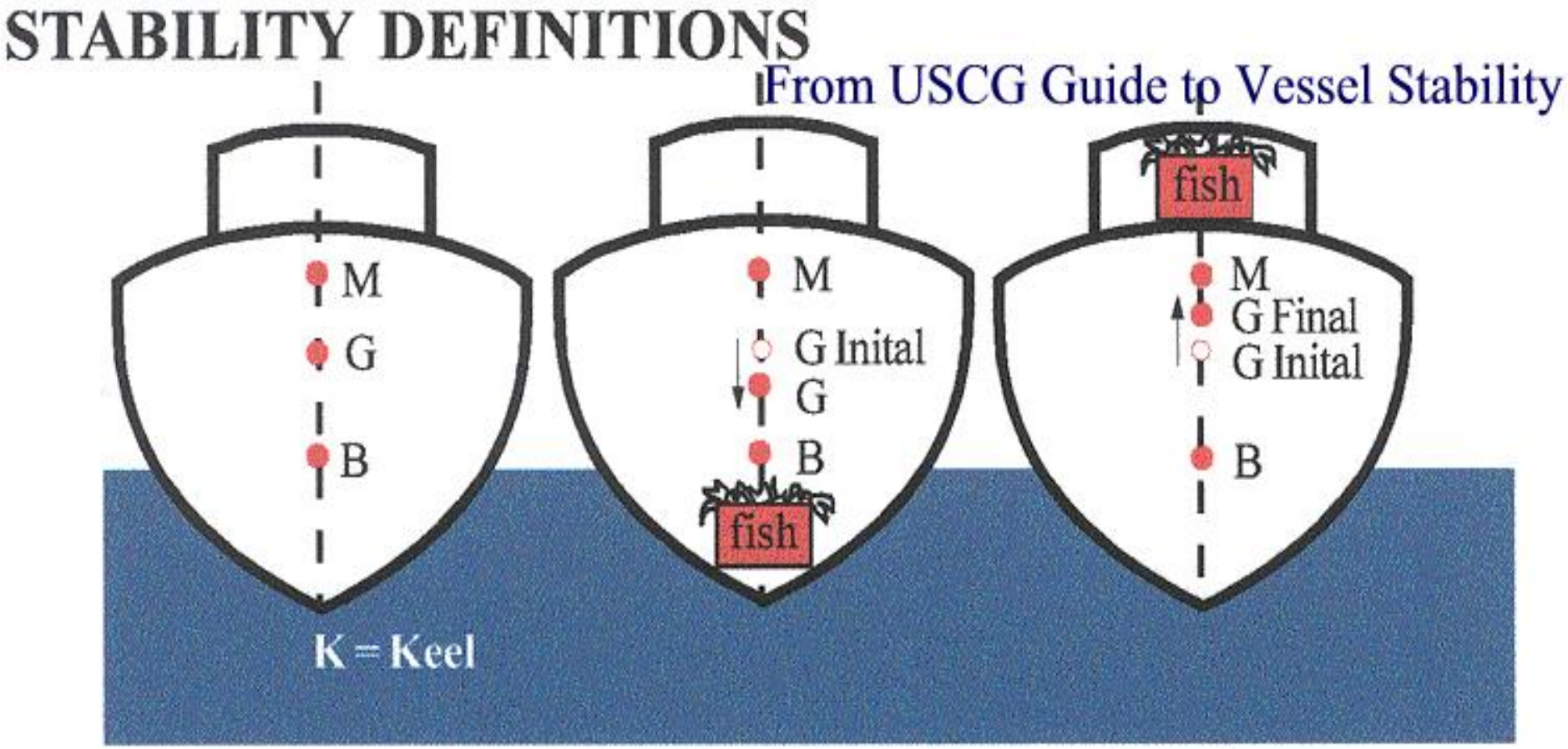
SNAME Panel on F/V Operations and Safety

Tasks of the SNAME F/V Panel

- **Working Group A: Investigate the feasibility of establishing risk-based fishing vessel stability criteria appropriate to the type of vessel and its operating area. (See Dahle 1995)**

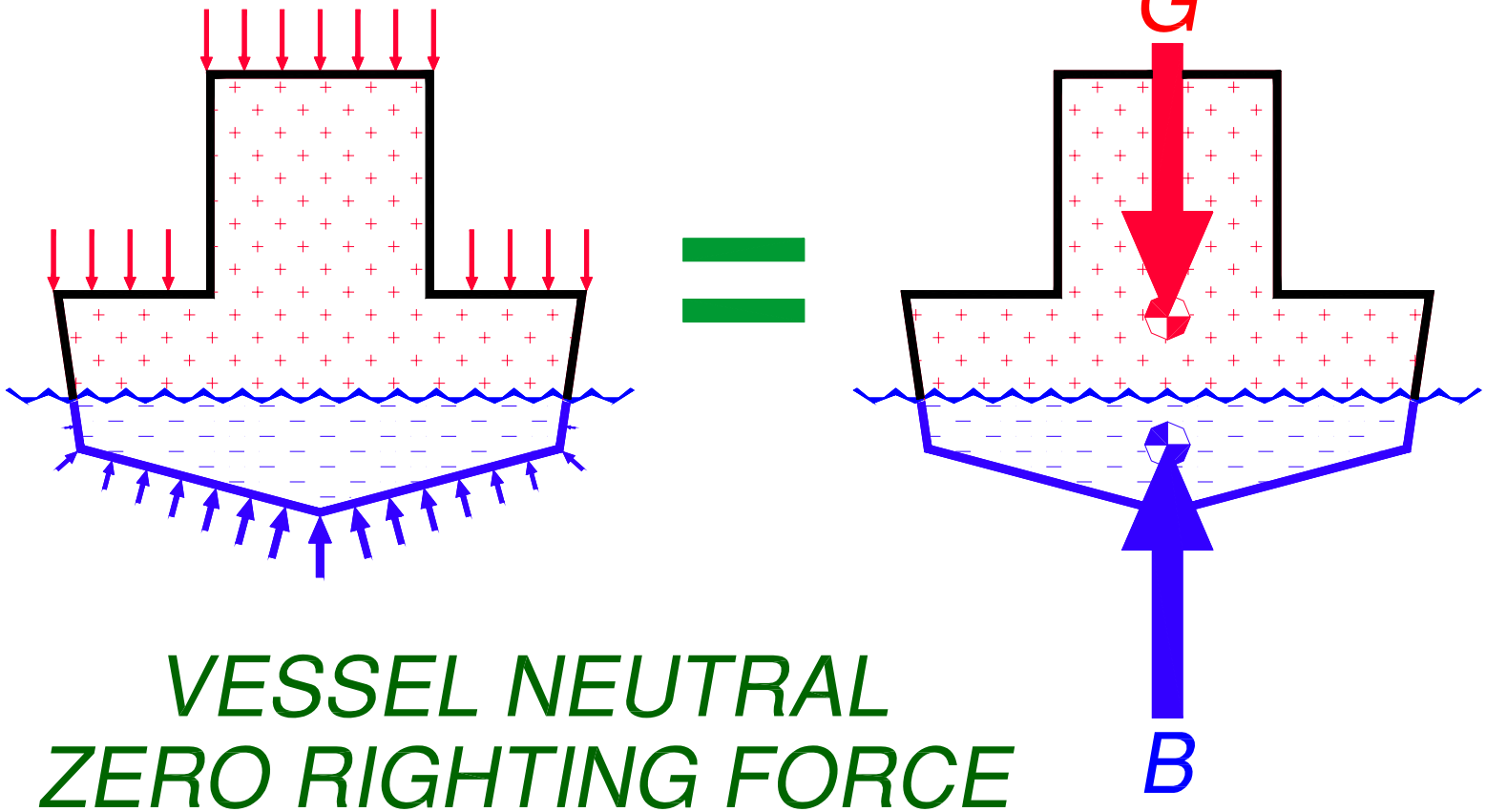
- **Working Group B: Evaluate the effectiveness of existing stability letters and develop better ways to communicate to the fishing community the importance of following reasonable stability and survivability guidelines.**

We must cease communicating oversimplified and incorrect fishing vessel stability concepts



Vessel Upright Stability

FIGURE 1



VESSEL NEUTRAL
ZERO RIGHTING FORCE

Inclined Stability

FIGURE 3

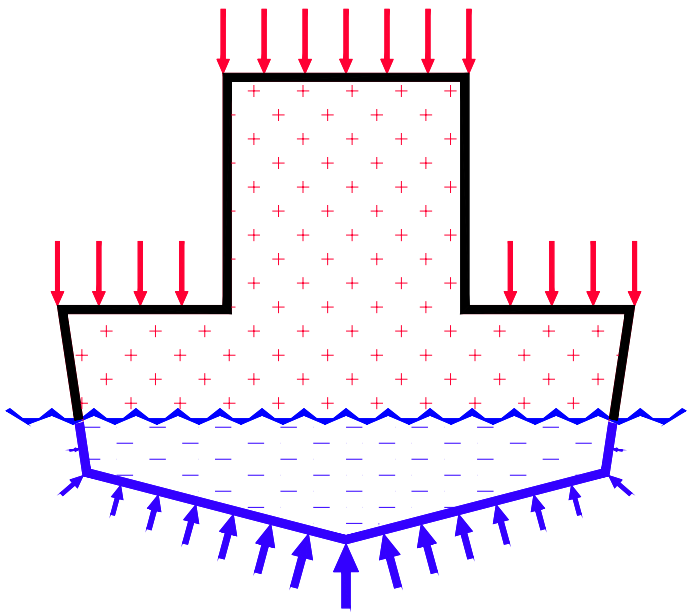


FIGURE 3A

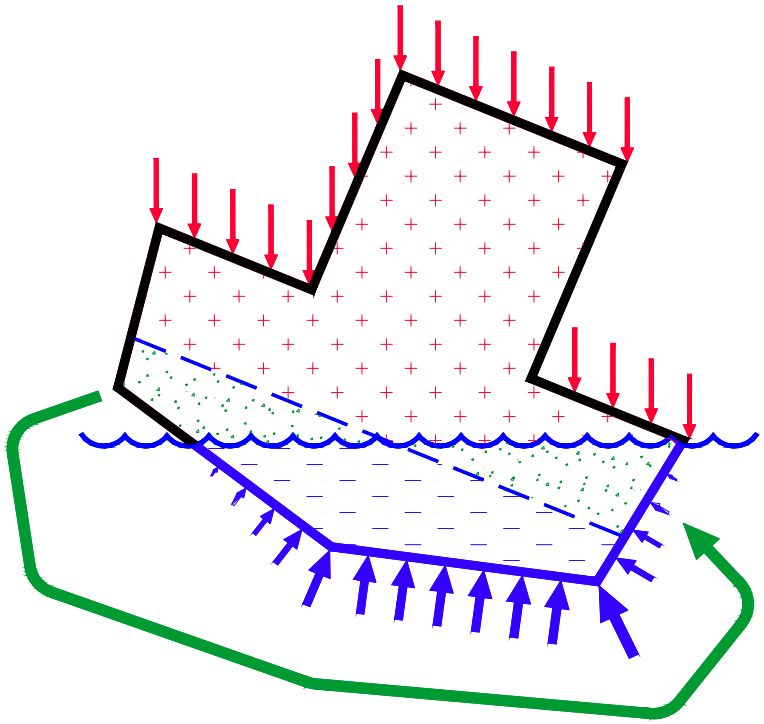
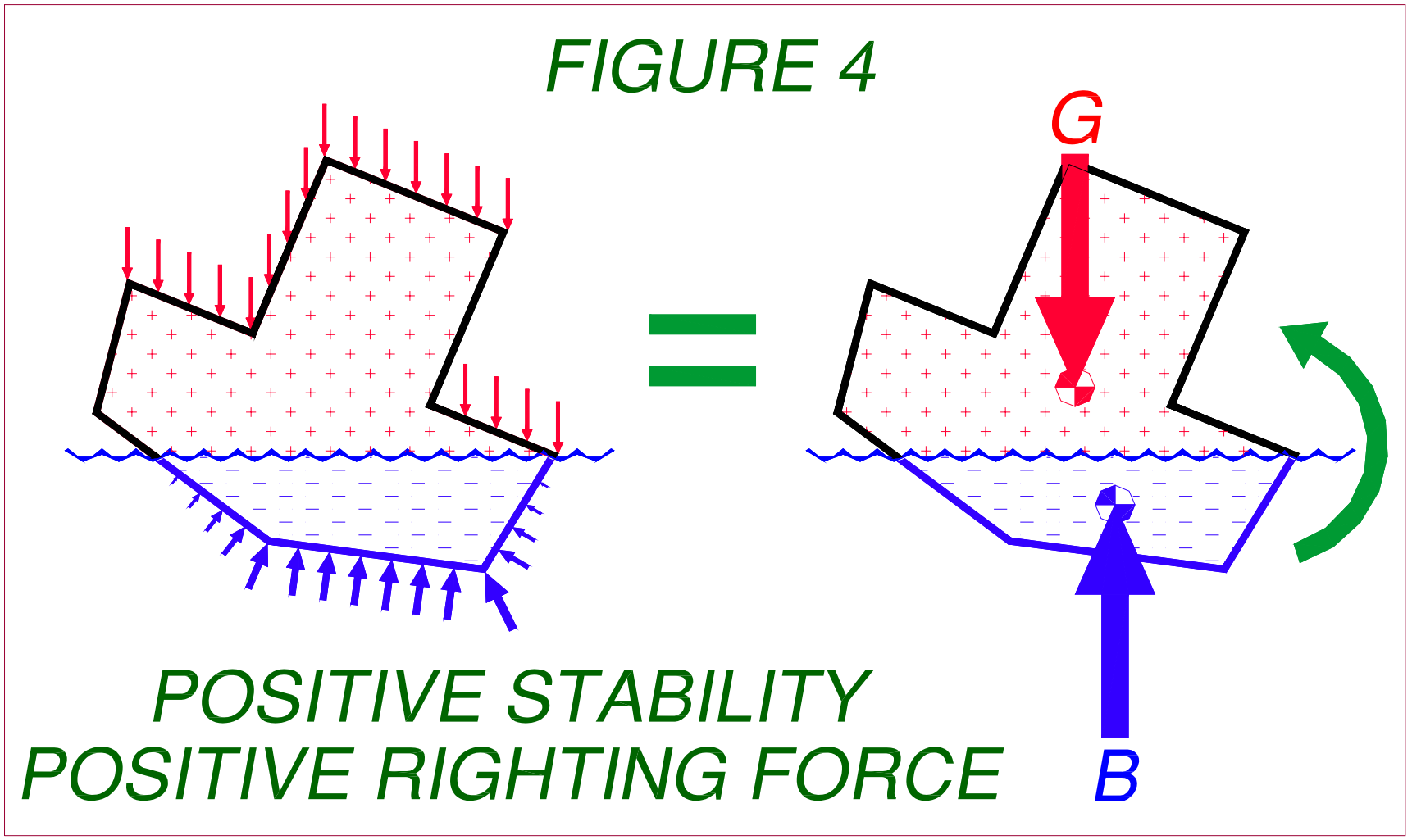
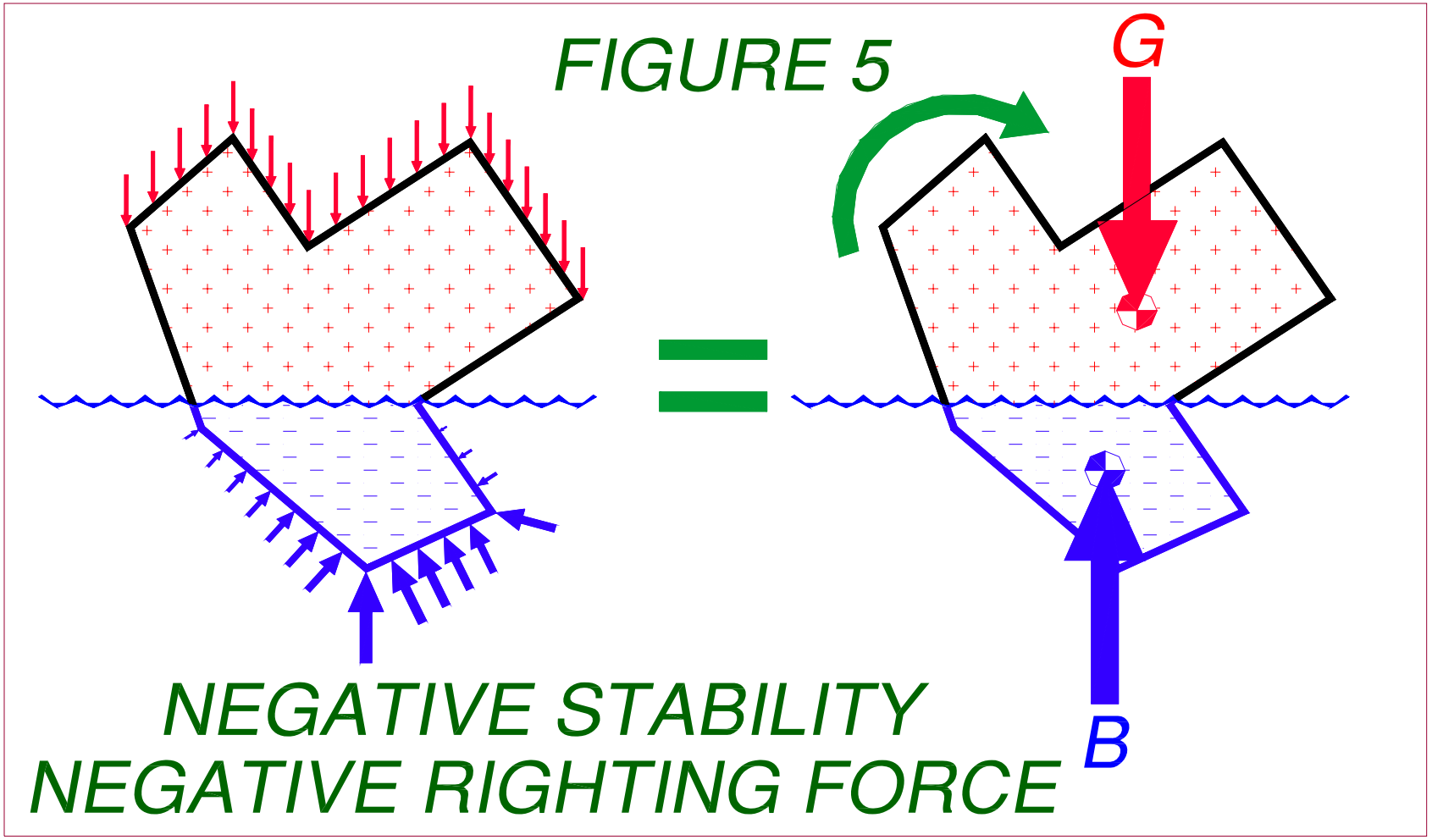


FIGURE 3C

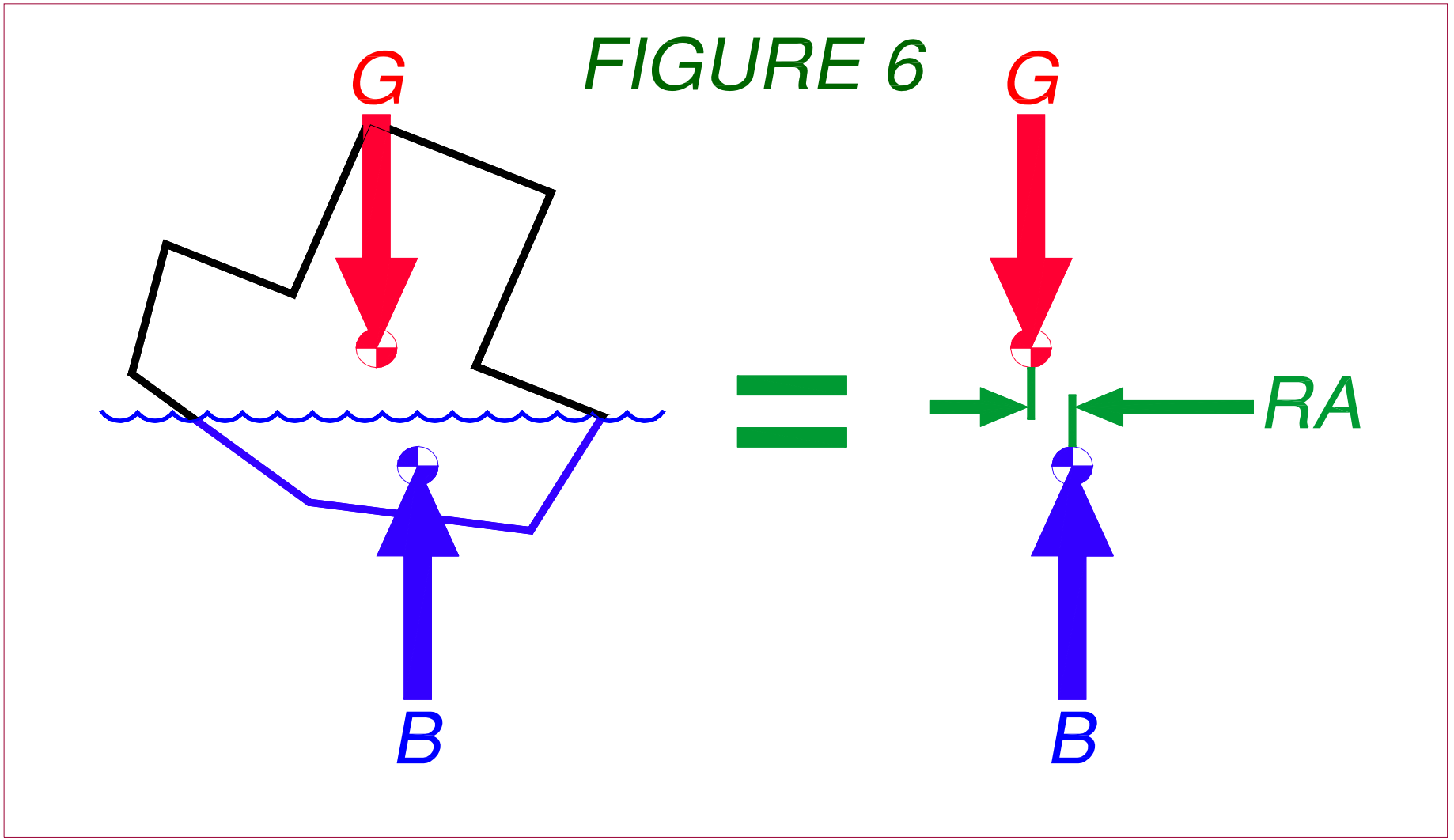
Positive Initial Stability



Negative Overall Stability

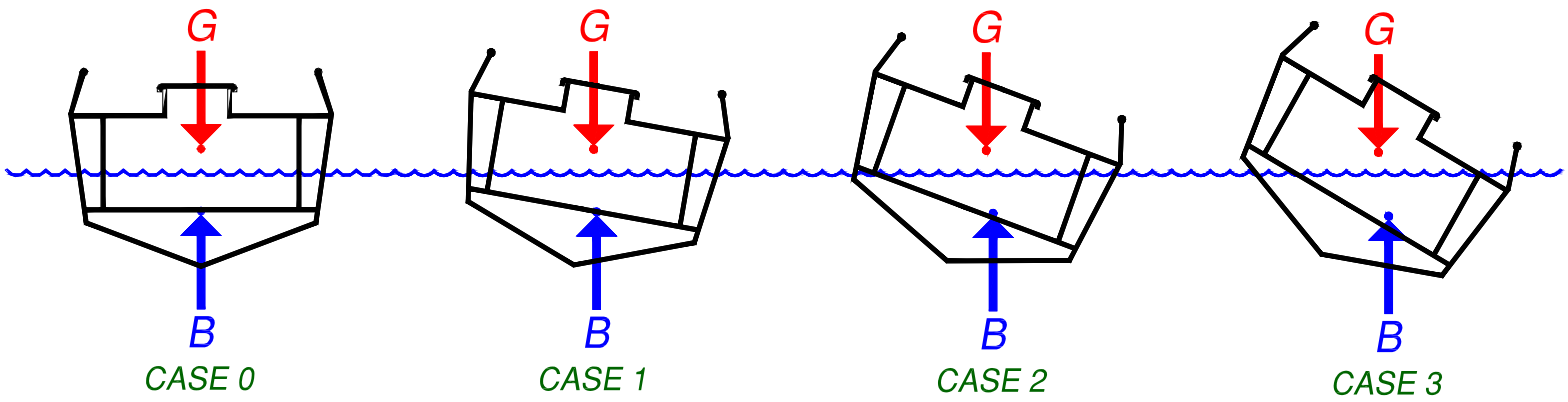


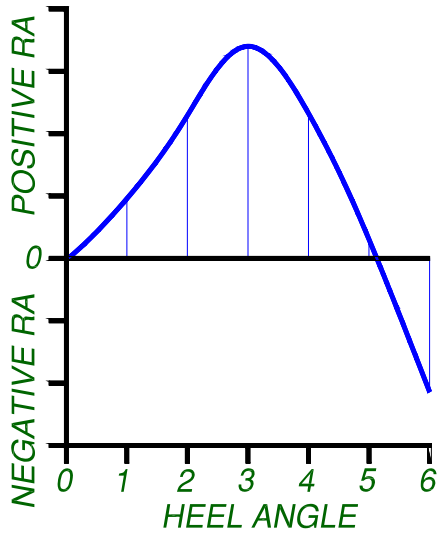
Righting Arm, RA



Overall Stability at Various Angles of Heel

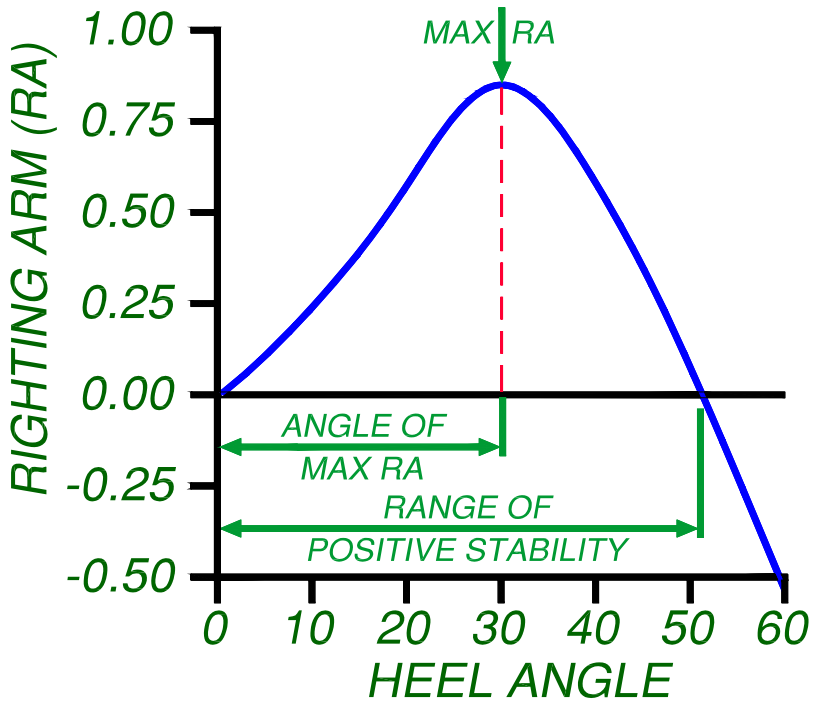
FIGURE 7

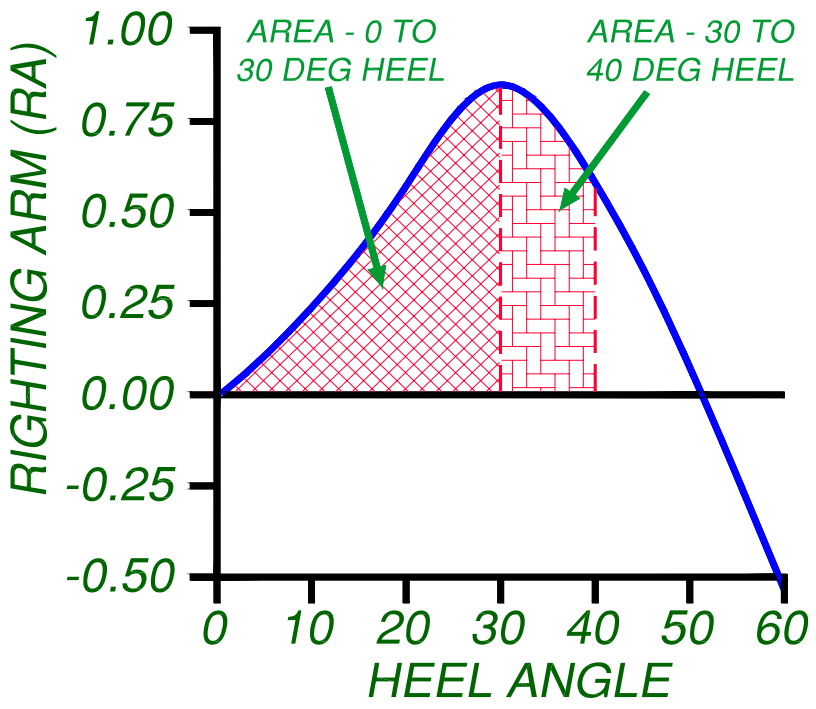




Frequently Used Stability Criteria

FIGURE 8





Frequently Used Stability Criteria

- A common interpretation of the Torremolinos Protocol stability criteria is that the area under the righting arm curve represents “righting energy”.
- A possible solution to this misinterpretation is to change the terminology to "unit righting energy" or even “unit static righting energy”. This interpretation is correct since the righting arm is righting energy per unit displacement, m-tons-degrees/ton (ft-tons-degrees/ton).
- (Work and energy are in lb-ft or N-m. See Appendix A, excerpts from PNA 1988, Volume 1, pp 87-93 on Dynamic Stability.)

Scalability

- **Briefly, scalability in vessel stability characteristics depends on the square-cubed rule, i.e. the heeling forces, which depend on water and wind impact areas, go up with the square of the dimensions but the righting moment depends on the displacement which goes up with the cube of the dimensions.**
- **Thus, bigger is almost always better!**
- **Correctly using the Torremolinos criteria should mean that vessels double in dimensions should survive without capsizing in twice the wave height conditions. However, that is not the interpretation generally given by the existing one-size-fits-all stability guidelines.**

Effect of Rise in CG

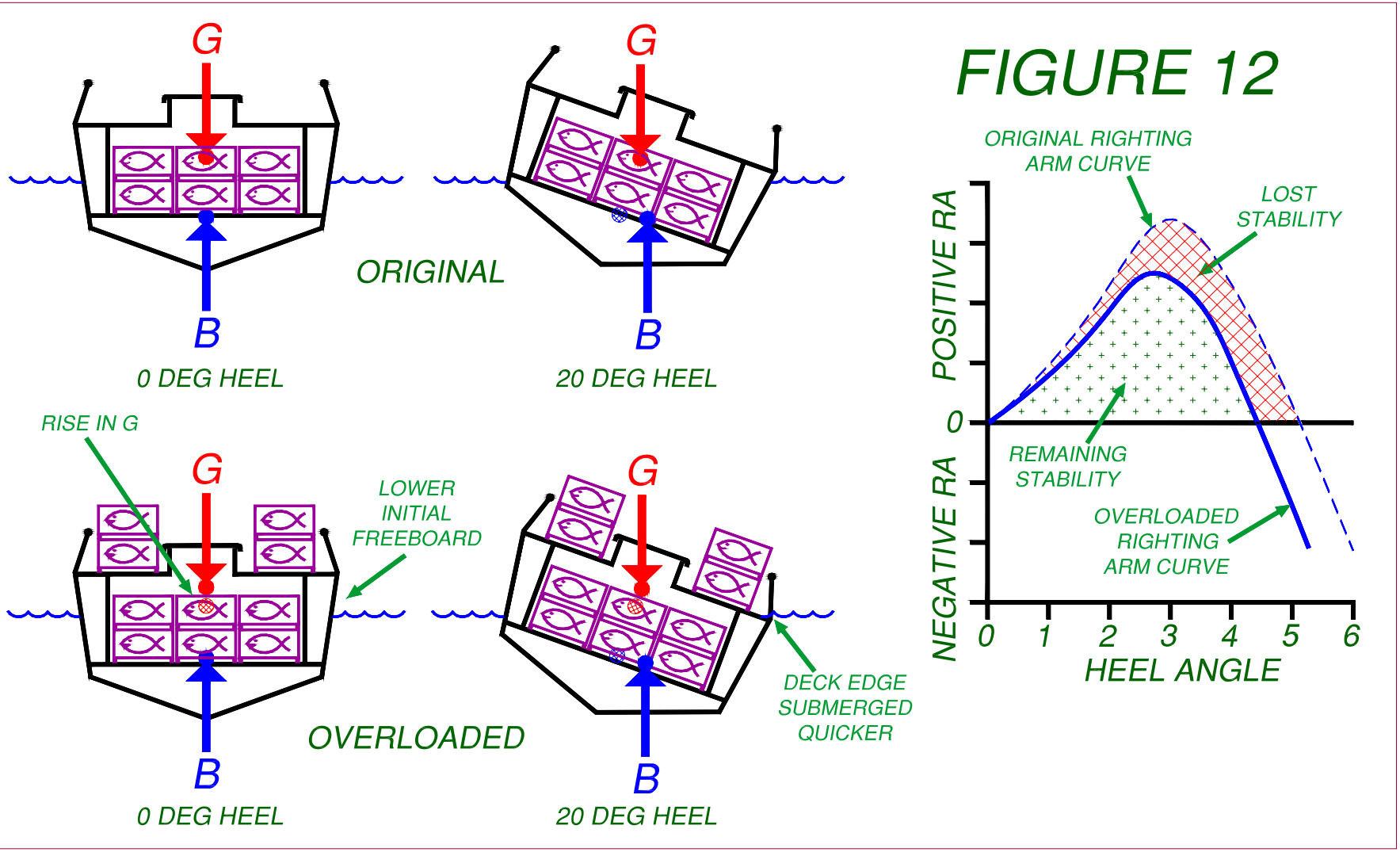
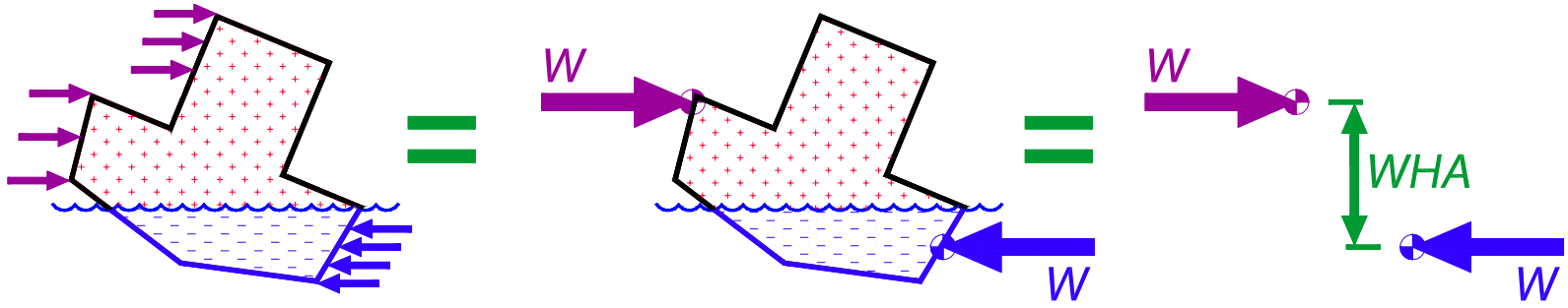


FIGURE 12

Effect of Wind Heeling



WHA = WIND HEELING ARM

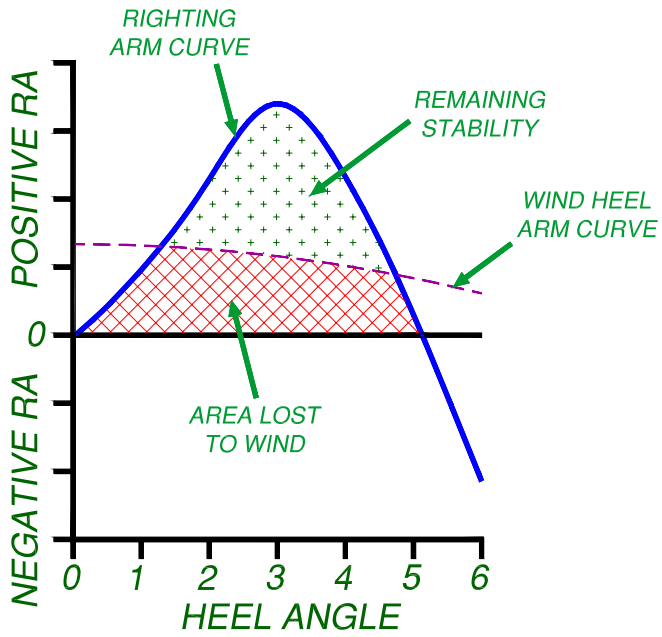


FIGURE 14

Effect of Wind Heeling

- The wind heel criteria do scale with size, as PNA points out, since the both the heeling arm and the righting arm are divided by the vessel displacement.
- This beam sea rolling criteria is used for the following example in the absence of other scalable criteria.
- Working Group A needs to address this problem.

Format Type A - Short Trip Length or Near Shore Operation

- To experiment with several simple approaches to developing this new version of the severe wind and roll criteria, trials were run on a typical Mid-Atlantic offshore clamming boat.
- The trials use educated assumptions to explore some general concepts and trends for using this criteria in less than full storm conditions.
- Full theoretical and model testing needs to be done to make robust, effective criteria.

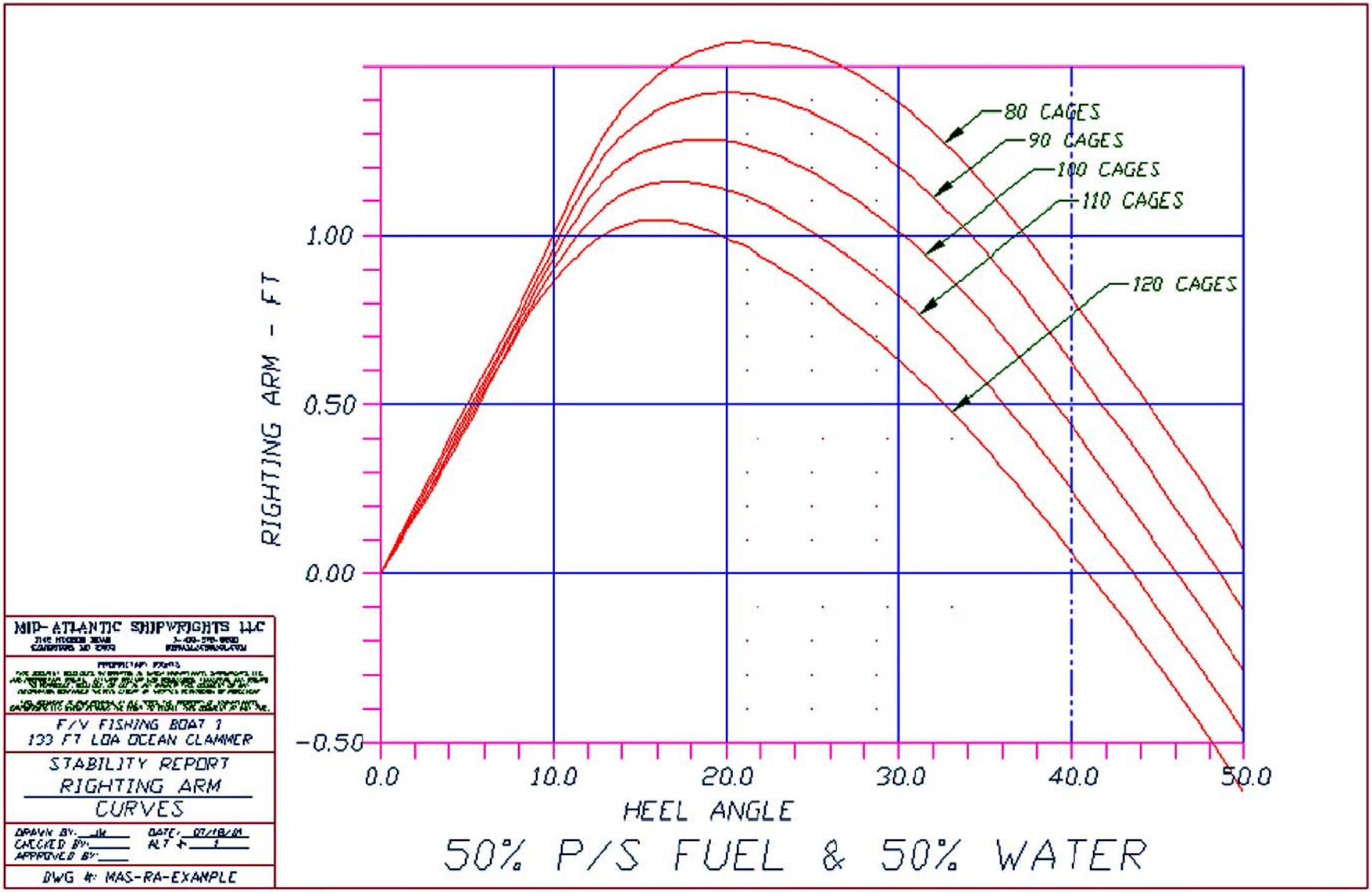
Format Type A - Short Trip Length or Near Shore Operation

- **The trial boat is a former 133 foot (40m) offshore supply vessel built in 1966 that was converted for use in the offshore clam harvesting fishery.**

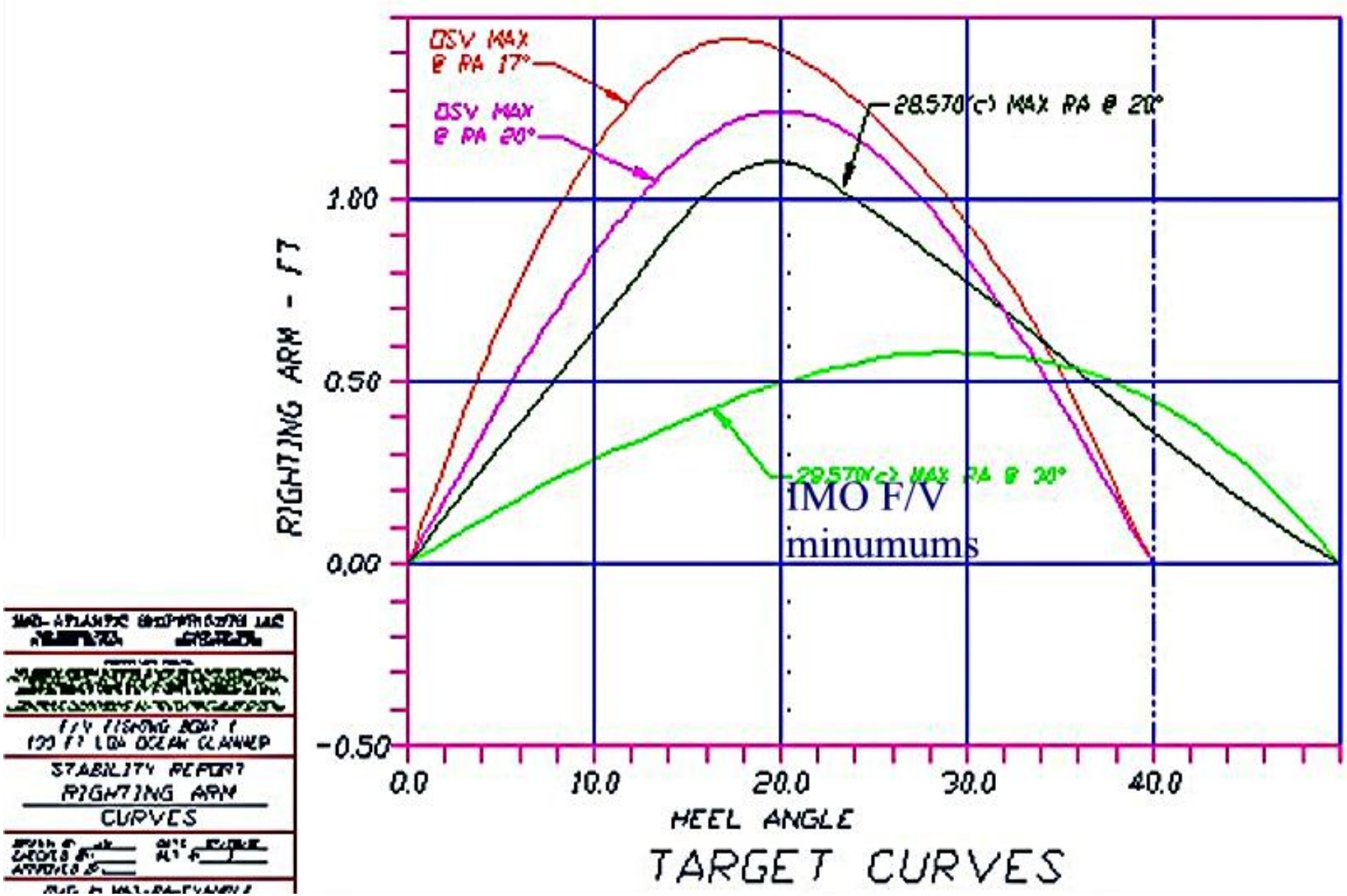
- **The boat operates on 24 to 32 hour dock to dock trips along the Mid Atlantic and New England coastline, typically ranging from 10 to 60 nautical miles from port. The catch is loaded on deck in steel cages similar to loading supplies on a typical offshore supply vessel.**

- **Due to the dredging gear, these clamming vessels generally work in winds less than 25 knots in order to keep the dredge in the sea bottom. Because of this wind restriction and the short trip times, this boat is ideally suited to weather dependent loading guidelines.**

Righting Arm Curves, 40 m OSV



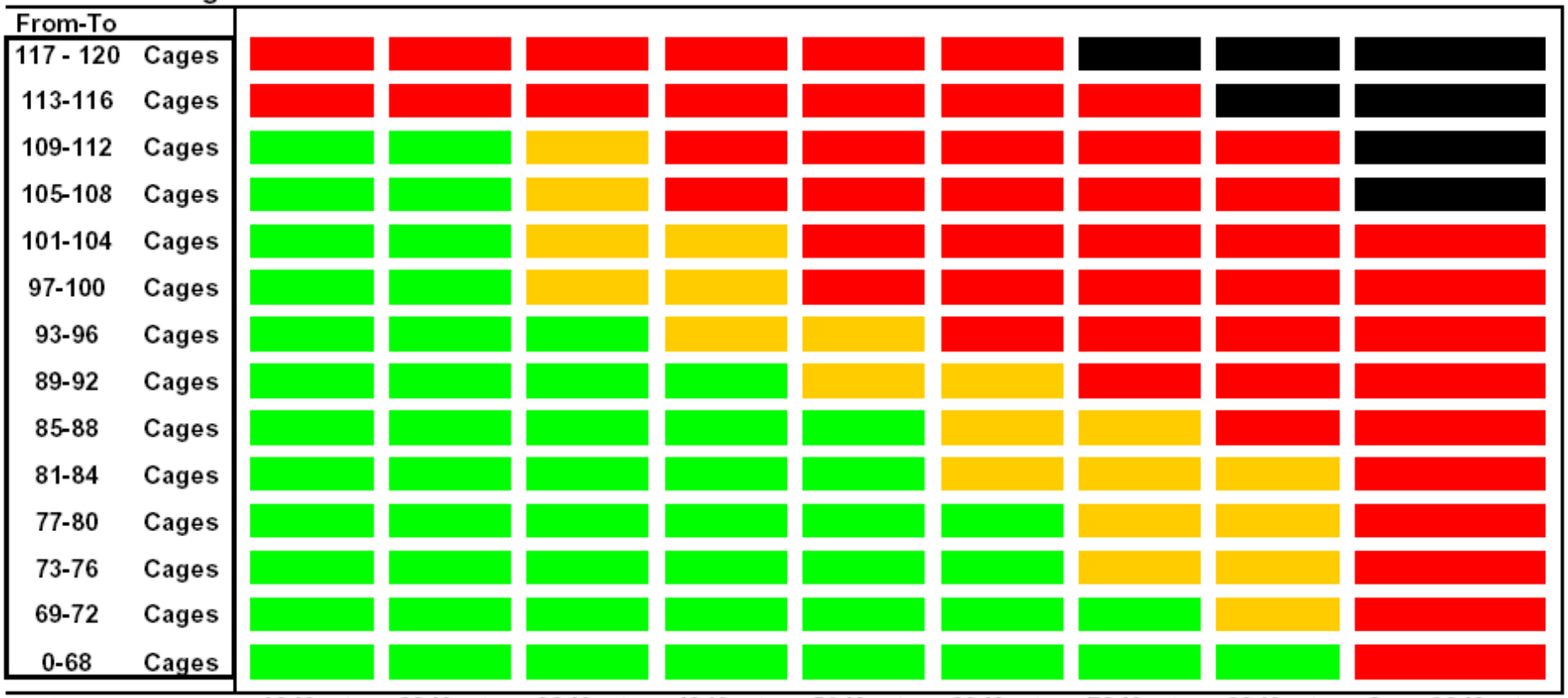
Criteria, 40 m OSV F/V Conversion



F/V # 1 40m OSV Clam Dredger - Safe Loading Table

Fuel Tanks 70% or Lower

All Loaded Cages are on the Main Deck



Sustained Wind Speed	10 Knots	20 Knots	30 Knots	40 Knots	50 Knots	60 Knots	70 Knots	80 Knots	Over 80 Knots
Expected Local Hs	0.8 m	1.2 m	2 m	3 m	4 m	6 m	9 m	12 m	> 14 m
Open Ocean Hs	0.8 m	2.5 m	4 m	6 m	8 m	11 m	14 m	16 m	> 16 m

Safe to Operate

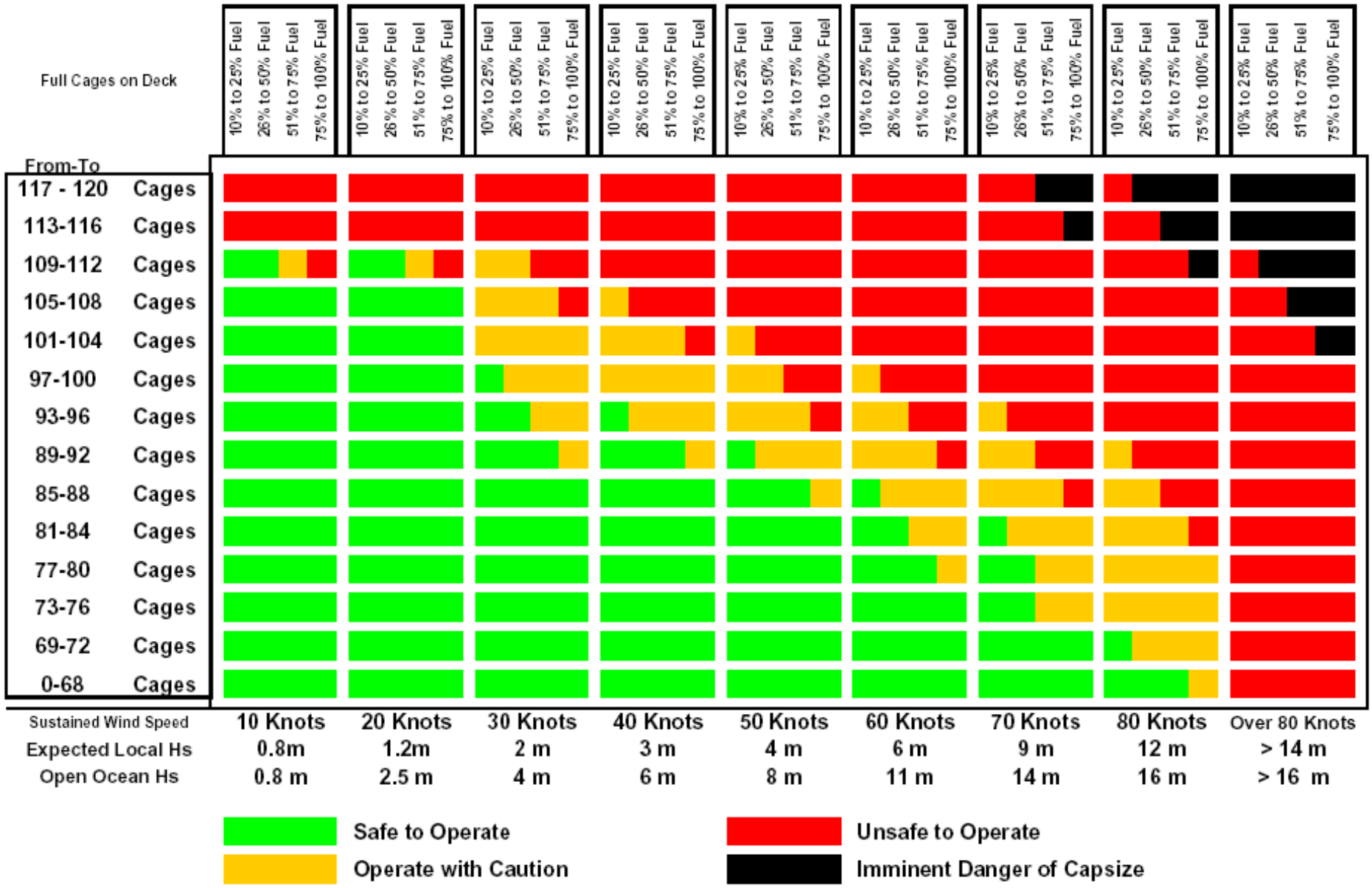
Operate with Caution

Unsafe to Operate

Imminent Danger of Capsize

F/V #1 40 m OSV Clam Dredger - Safe Loading Table

Fresh Water Tank any Level



Format Type B - Offshore Operation

- Fishing boats that work on extended trips with no port of safe refuge available within a reasonable steaming range can also take advantage of a risked based loading matrix.
- In this setup, current weather conditions are not factored into the stability review. The fishing boat's stability would be evaluated against an appropriate worst case storm conditions to be expected for its fishing grounds.

F/V #2 40m Stern Trawler - Safe Loading Table B-1 - Unrestricted Ocean Service

Fresh Water Tank any Level