

CONTAINERSHIP LOSSES DUE TO HEAD-SEA PARAMETRIC ROLLING:
Implications for Cargo Insurers

Richard G. Roenbeck
Senior Account Executive – St. Paul Global Marine

It is a pleasure to be here today to speak to you about a situation which is only of late being recognized for what it is and the adverse potential it presents to the marine insurance community.

We are very fortunate to have the genuine expert, Bill France, on this panel. His excellent paper and presentation today affords a clear definition of the phenomenon of head-sea parametric rolling and the dimensions of a problem the magnitude of which, in my opinion, marine insurers and reinsurers do not yet fully appreciate.

“Parametric rolling is an unstable phenomenon, which can quickly generate large roll angles that are coupled with significant pitch motions. The rolling occurs in phase with pitch, and on containerhips introduces high loads into the containers and their securing systems. It appears that post-Panamax containerhips may be particularly prone to this behavior. This is an important issue considering the LARGE NUMBER of these vessels scheduled for delivery in the next few years.” (W. France – Healy & Baillie, LLP, M. Levadou – MARIN, T. Treakle – SAIC, J. R. Pauling – Univ. of CA (Ret.), R. K. Michel and C. Moore – Herbert Engineering Corp. “An Investigation of Head-Sea Parametric Rolling and its Influence on Container Lashing Systems”) ¹

Now a quick look at the culprits.

Post-Panamax container ships are so named because they are too large to transit the Panama Canal. These giants, the largest at present having a cargo carrying capacity of over 7500 TEU's are restricted to certain trades (primarily trade routes between the

Pacific Rim and West Coast of the US) because not many ports are ready to receive them. Despite these port constraints, orders for new and larger ships are robust.

“At present several major containership lines, including Taiwan’s Evergreen Line, Korea’s Hyundai, and the British-Dutch P&O/Nedlloyd lines, operate post-Panamax liners and have more on order. Maersk-Sealand built the first vessel in this class and with 21 of the mega-container ships in service, it dominates the post-Panamax group (and, indeed, the world’s containership business).” **“These giants carry enough containers which, if placed end-to-end, would stretch for 27 miles, and they are slashing operating costs.”** (Philip Siekman. FORTUNE MAGAZINE. “INDUSTRIAL MANAGEMENT AND TECHNOLOGY – The New Wave in Giant Ships. October 31, 2001)²

There are a number of 8,100 TEU vessels on order in Korean yards now. It is the trend in containership construction which is germane to this discussion. “The world container fleet shows the fastest growth of any ship type. Today the fleet of about 2,800 fully cellular container ships with a total of 68 million Gross Tons accounts for 12% of the world merchant fleet tonnage. In 1995 this share was at a mere 5%. There has been no comparable development with any other ship type in the history of shipping. Some of the growth is at the expense of the traditional general cargo ship. This ship type is being replaced today by multi-purpose vessels or by pure containerships. The containership has become the dry cargo carrier of the future.” (Hans. G. Payer – Germanischer Lloyd. “Economic and Technical Aspects of Mega-Container Carriers”. Annual Conference of International Association of Maritime Economists (IAME), 13 – 25 November 2002).³

Referring to the chart we see that between 1996 and 2002 new construction in cellular ship capacity increased by over 3,000,000 TEU’s, or a 10.8% increase over the last seven years.⁴ ATAS News No. 02/2003 Edition 114 February 2003. “Cellular Fleet Growth – January 2003.”

The year 2003 will see the delivery of a further 544,000 TEU's. Adding the projected new buildings for 2004 and 2005 brings the total to over 7,000,000 TEU's in new capacity. "However, there are vast differences in the growth of the fleet broken down by the sizes of the vessels. Most of the TEU growth has been contributed by ships over 4000 TEUs. For the new construction between 1996 and 2002, the capacity of ships over 4000 TEU's has risen nearly 26% per annum against a 6% rise for all the cellular ships under 4000 TEU's.⁵ (ATAS News) The profile of the world containership fleet has changed dramatically: in 1996 over 85% of the fleet was made up of vessels below 4000 TEU's; by the end of 2004 this figure will be below 60%." At 40% of the world containership fleet, and that trend likely to continue, the culprits are becoming more numerous. Remember it is the post-Panamax vessels (i.e. greater than 4000 TEU) which are experiencing the head sea parametric roll phenomenon. Put into insurance terms, the **frequency** potential for large containership losses is increasing as the make-up of the world fleet is steadily moving towards larger and larger vessels.

The slide detailing the incidents of containership losses also serves to illustrate the issue of frequency. These are not rare or occasional events. They happen several times a year, year in and year out. **"The number of containers lost overboard has been reported to be somewhere between 2,000 and 10,000 each year."** (Position paper, Alliance of Maritime Regional Interests in Europe. "Gross Tonnage and Container Safety at Sea and at Ports.")⁶

A quick aside: if you search the Internet for information on containership losses, you will find a number of sites posted by yachting / recreation boating associations expressing concern or annoyance about the growing number of floating and submerged cargo containers cluttering up the coastal waters in which they navigate. So for those of you who insure yachts and recreational boats, take heed!

Moving on, underwriters are not only concerned with loss frequency, but, of course, also the **severity** of losses. The APL China event clearly demonstrates the enormous large loss potential which results when a vessel encounters the proper conditions and is

subjected to head-sea parametric rolling. The fact of the matter is that the APL China was not a very large vessel compared to the latest generations of Post-Panamax containerships. And there are plans on the drawing board for vessels which will dwarf the largest ships now under construction.

The largest containerships at sea today have 7,500 TEU capacity and 8,100 TEU vessels are under construction. It is technologically feasible to build larger containerships and 10,000 TEU vessels are planned. But naval architects and classification societies envision really enormous vessels. Feasibility studies for containerships of 18,000 TEU capacity are being examined. "Malacca Max" vessels (so called because they would barely be able to navigate the Straits of Malacca around Singapore without grounding) would have:

- length overall of 400 meters;
- beam or breadth of 60 meters;
- draft of 21 meters;
- dead weight tonnage of 242,000 DWT (these dimensions put it in the category of a VLCC);
- on-deck stack heights of 7 or 8 tiers high and
- stowage of 22 containers across the width of the hatch covers (as compared to 17 across on the largest "S" class vessels currently in service)

(Payer)⁷

Recall that I mentioned earlier that if we put all of the containers carried on a Post-Panamax vessel end to end, they would stretch for 27 miles. Doing the same with the containers carried on a Malacca Max vessel, the boxes would stretch for 68 miles. (Siekman)⁸

With each new generation of containership, we have more cargo, of greater and greater value carried in more containers, stacked ever higher below and above deck. The

euphemism of “eggs in a basket” is nowhere more appropriate in marine transportation than with the still evolving arena of intermodal containership service.

An article appearing in the Journal of Commerce in March, 2000 reported that according to the UK P&I Club, **the “average cost for containership claims increased by 447% from 1991 to 1999.”** (Robert G. Mullins. Journal of Commerce. March 29, 2000. “Average cost of container ship claims increased by 447% from 1991 to 1999.”)⁹

Further, the Club advised that Year 2000 results included 11% of its container claims was a result of boxes lost overboard and that the average value of each claim was around \$400,000 per occurrence for lost containers overboard. (AMRIE)¹⁰

To get an appreciation of the magnitude of the cost associated with “container overboard” losses, we can refer to figures obtained from Piers data from 1998. By inspection you will see that the average value per container for imports to the US is higher than for exports from the US. This makes sense when one considers that the US imports a preponderance of finished goods, especially from the Pacific Rim, whereas one of the major exports from the Port of New York is waste paper. In any event, assuming that the weighted average of imports and exports approximates containerized traffic around the world, and allowing for very modest inflation since 1998, the arithmetic “average” value of the cargo in a Twenty-foot Equivalent Unit (TEU) is \$44,346. Multiply that by 10,000 containers overboard in a given year, and cargo underwriters are facing claims in excess of \$443,000,000 just for containers lost overboard. Bear in mind that this number has to be modified upwards since the Piers data is based on landed cost values. Allowing for the preponderance of insured goods being valued at some variation of selling price, the quantum of the problem can, in fact, be dramatically higher.

It is inappropriate in this forum to specifically discuss “average rates or premiums” for containerized cargo shipments, but I have done a bit of mental arithmetic and suggest that it is not at all out of line to imagine that for each container lost overboard, a marine

underwriter might have to insure 1000 “average containers” free of loss just to break even. Again, given that as many as 10,000 containers are lost over the side each year, this example illustrates that marine insurers collectively have to insure far more shipments without incident just to cover the loss of containers overboard.

Referring once again to the values of cargo carried in our “average” TEU, a fully laden Malacca Max containership of 18,000 TEU would present an accumulation of cargo values of \$800,000,000 at landed cost valuation; meaning that the actual cargo TIV would be in excess of \$1 Billion for any fully laden voyage.

Imagine if one of these vessels, fully laden, sinks. Or imagine the financial loss if one of these ships suffers a catastrophic fire similar to the one aboard the HANJIN PENNSYLVANIA recently which resulted in an effective total loss. Worse still, imagine two of these behemoths involved in a collision in a congested waterway (like the Straits of Malacca)! Are we potentially looking at a marine insurance loss approaching \$2 Billion? **Imagine** a Malacca-max containership, carrying as many as 8000 containers **on deck**, most stacked 7 to 8 tiers above the hatch covers, experiencing the extreme conditions of simultaneously rolling and pitching far beyond anything the naval architects and container designers modeled as conditions the ship would face at sea. Marine insurers need to be imagining, indeed planning for these very events.

In light of both the growing frequency of losses attributable to head-sea parametric rolling and the almost unimaginable cataclysmic severity of claims involving these mega containerships, the question for marine insurers (and reinsurers) becomes obvious: are we underwriting our business properly and /or pricing our business adequately? It would be difficult to assert that we are allowing for these types of losses in our basic FPA rates when (I think it is fair to say) underwriters are not even aware of the phenomenon.

This, of course, does not take into account the particular average losses which inevitably occur in conjunction with heavy weather induced losses, with or without the occurrence of head-sea parametric rolling, which only exacerbates the problem.

Economy of scale is the underlying reason behind the push toward larger and larger container ships and the change in the makeup of the world fleet (that is 40% of the world container fleet are now Post-Panamax class vessels). In their quest for ever more cost effective operations, the major container ship lines cut costs in other ways, too; these “shortcuts” are an everyday reality of international marine transportation. For example, IMO regulations require every ship to have a Cargo Securing Manual (CSM) on board at all times. Cargo Securing manuals provide stowage and securing instructions for **pre-approved** load conditions. The fact of the matter is, however, that carriers routinely sail ships in violation of the CSM. (I have it on excellent authority that on any given day upwards of 60% of container ships are abrogating their CSM’s. (CAPT. J. McNamara, President, National Cargo Bureau).¹¹

Examples include:

- excessive stack weights both below deck and deck loads on hatch covers;
- damaged / marginal containers, especially on-deck containers with corner post damage
- adding additional tiers of deck containers not contemplated by the CSM;
- use of already-damaged lashing gear;
- improper installation and/or improvised use and/or inadequate number of wire lashings, interbox connectors and/or bridge fittings, and sometimes not using this gear at all (which is sometimes a function of local longshore labor rules);
- improper stowage of 20-foot containers in 40-foot spaces leaving one end of each container stack unsecured;
- unsecured hatch covers which permit small lateral movements of entire deckload stacks which slacken or excessively strain the securing system and so on.

There is not sufficient time in this presentation to go into any detail on the related subject of danger posed by design deficiencies in modern ship construction. This separate problem is most often referred to as scantling optimization. Whole generations

of scantling-optimized ships have presented marine underwriters with unanticipated potential for tremendous losses, not to mention very significant damage claims over the years. The following quotation illustrates:

Quote

“I believe the risk attached to the continued acceptance of minimal initial scantlings and corrosion margins, and the short life ships they spawn, is too great for this industry to feel comfortable.” Unquote. Robert D. Somerville, President of the American Bureau of Shipping so informed delegates to a shipping conference in Athens and reported in the ABS publication ACTIVITIES in January, 2002. (ABS periodical ACTIVITIES. “Scantlings Should Not Be a Matter of Negotiation.” The Industry, January, 2002)¹²

Indeed, we can get hull underwriters in on this discussion since we are facing the **certainty** that the newest generations of mega-containerships are also scantling-optimized vessels. How will these scantling optimized giants fair when subjected to conditions of sea and weather which give rise to head-sea parametric rolling? Right now the answer resides in the realm of conjecture, but the harsh reality may be upon us in the very near future.

Bringing the several points together, the environment in which marine cargo insurers endeavor to evaluate marine transportation risks is:

1. the increasing size of containerships ships presents the escalating exposure of “many, many eggs in one basket”;
2. steamship carriers are cutting corners in order to compete, the result of which are instances of improper / substandard stowage, particularly of containers stowed on hatch covers, and
3. add to these factors the phenomenon of head-sea parametric rolling which appears to be inherent to the design of scantling-optimized, post-Panamax containerships.

This combination of conditions presents for marine insurers and reinsurers the almost certain probability for unforeseen, unanticipated catastrophic losses in the future.

What to do? There are already fleets of these “5th generation” post-Panamax containerships plying the world’s maritime trade routes. Shipyards have orders in hand to build more of these vessels. Naval architects and classification societies are even now working to solve the technical issues of the future generations of still larger mega-containerships, while ports around the world scramble to build the infrastructures necessary to accommodate these behemoths.

While all this activity is going on, how is the catastrophic loss potential of head-sea parametric rolling being addressed? Not surprising, not a great deal is being done. The varying and divergent interests of the players in the marine transportation business are often at odds, and in that situation problems are sometimes ignored or wished away.

It is encouraging to see that Society of Naval Architects and Marine Engineers is still hard at work on the issue of head sea parametric rolling. The Ad Hoc panel #13 undertook an “Investigation of Head-Sea Parametric Rolling and Resulting Vessel and Cargo securing Loads on April 30, 2002. Their final report, promised for sometime in 2003, will hopefully provide further guidance to naval architects and shipyards which will address or at least ameliorate the situation. (SNAME Ad Hoc Panel #13. “Investigation of Head-Sea Parametric Rolling and Resulting Vessel and Cargo Securing Loads”. April 30, 2002)¹³

But the marine insurance industry has a vital stake in this issue. We are only now becoming aware that the problem exists. Up to this point we only have a hint as to the catastrophic loss potential which attends **every time** a post-Panamax containership puts to sea. It is not a question of **if** it will happen; given the right sea state, 5th generation containerships will inevitably experience the horror of head sea parametric rolling with all of the attendant damage to ship and cargo (and possibly lives).

The problem has been defined. What to do? For starters, employ the basic underwriting process. Underwriters must learn everything they can about the risk and evaluate it. As attractive as the notion is, it may be impracticable to “reject or modify” the risk, given the preponderance of tonnage and world commerce which moves on containerhips. But neither is it an option to stand mutely by, hope for the best, and then end up cutting enormous checks following post-Panamax boxship losses. Nor is it sensible to rationalize that the spread of risk is such that no individual marine insurance carrier or market will be too adversely affected by these occurrences. How many of you have Fortune 500 assureds on your books, or assured’s who may not be brand name operations but import or export based on seasonal demands? And lest we forget, cargo policies include the Accumulation Clause which allows for up to two times the vessel limit when unexpected delays cause cargo to pile up at some point in the logistics chain.

The point is that any of us can be faced with extremely large losses resulting from mega-containerhips tangling with Mother Nature and taking a ride on the parametric roller coaster. Just ask your reinsurer(s) about how unpleasant it can be to go to work after one or two catastrophic losses accrue on the books.

I am not advancing any hard and fast plan of action nor advocating that the marine insurance industry take any impulsive steps now that would set containerhip trade on its collective ear. I am saying that we need to be aware of the phenomenon of head sea parametric rolling and the potential it presents for catastrophic loss. Our job is to select acceptable risks and price them to achieve underwriting profit in line with our respective corporate goals. Given that charge, and, in light of the perils and loss potential presented by head-sea parametric rolling, it behooves us to step up, take the initiative, and get engaged in the conversations and activities which are going on RIGHT NOW about how to address the safe transportation of the cargoes we insure, which move 24 hours a day, 7 days a week, on the latest generation of containerhips afloat; containerhip fleets soon to be augmented by the ultra large containerhips still on the drawing board.

IUMI is an excellent forum, indeed the most appropriate arena, in which to develop a plan for action . All of the underwriting and technical talent is present here to undertake an analysis of the problem and the potential solutions. In this place there are world wide contacts and business connections, which are essential to ensure that, as an industry, our concerns are known and our interests properly represented as deliberations and debates go forth on how to address the hazards posed by this phenomenon. This is NOT the time to sit idly by on the sidelines and “see what develops”. If the marine insurance industry fails to take this bull by the horns, we will come to grips with it in the future, but at a cost none of us would care to contemplate.

Ladies and gentlemen, I thank you for your attention today and hope that you found the discussion informative.

Thank you.

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