IACS

Session 3(a) - Workshop on the evolution of IACS CSR

07 November 2024

Tripartite 2024

Shanghai, People’s Republic of China

Introduction

Rationale of updating CSR

- IACS has carried our revisions to the CSR as part of the continual ‘class cycle’ of review and improvement. The revisions reaffirm IACS’s commitment to maintaining the highest standards.
- The basis for revisions to CSR (including new wave loads and other subsequent rule changes) will be more transparent and accurate as it is based on more realistic and validated data and experience gained in service, and a more comprehensive and technically sound background compared to the previous CSR.
- IACS anticipates that revisions to CSR will not impact the potential lifespan of a vessel, and therefore no devaluation on asset price.
- Since the last major revision of the CSR, significant technological advances have been made. These include improvements in simulation tools and structural analysis techniques, which can now be better integrated into the rules to enhance safety and efficiency.
- The shipping industry has also evolved, with new challenges and changes such as digitalisation and environmental concerns becoming more prominent. A review of the CSR is essential to ensure that the rules remain relevant and continue to support safe and sustainable shipping practices.

Introduction

Rationale of updating CSR

- CSR revisions are made with all stakeholders in mind, and as part of a truly collaborative process. Revisions to CSR are subject to extensive scrutiny by all stakeholders (including, but not limited to External Advisory Group (EAG), IACS members' technical committees, and wider industry consultation). All rule changes are accompanied by detailed technical background documents, ensuring a fully transparent process.
- CSR revision review process includes ample time for Industry consultation, allowing stakeholders to provide feedback and ensure that the changes reflect their needs and operational realities.
- The new revised CSR will streamline the design and construction process, incorporating the latest standards that will reduce rework and enhance the quality and safety of newbuilds.
- All CSR revisions are subject to IMO GBS audits to ensure compliance with respective Goals and Functional Requirements.

Benefits of updated Rec.34 and Wave Load

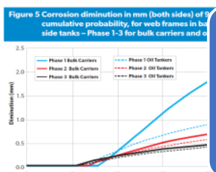
- Combines experience and advanced consistent calculations
- Insight in wave environment experienced by existing ships
- Better positioned to:
  - ✓ Predict scantling increases when experience is not available e.g. due to unusual hull shapes/sizes, intended operation or increased speed,
- Improvements in simulation tools and structural analysis techniques, which can be better integrated into the rules to enhance safety and efficiency.
- Remain relevant and continue to support safe and sustainable shipping practices.
- With enhancements represent a significant improvement to modelling real-world conditions, supporting the ongoing evolution of ship design and safety measures.
- Incorporate the latest safety standards based on more accurate and recent data, which will lead to improved ship design and construction, ultimately helping to reduce the risk of accidents at sea.
- Allow for greater preparedness in meeting the demands of inevitable changes to environmental standards, including provisions for more environmentally-friendly ship designs, adding new clean technology such as wind propulsion or air lubrication, and adapting to new fuel types.

Overview of IACS Project in the revisions of IACS CSR

(2016) IMO GBS Initial Audit

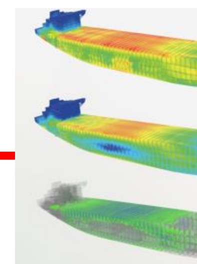
(2020) Corrosion Analysis
- Comprehensive statistical analyses conducted
- Developed TB of CSR Corrosion

(2022) Revision of IACS Rec.34
- First major revision since 2001
- New wave scatter diagram based on hindcast data with AIS information
- Validated by multiple sources

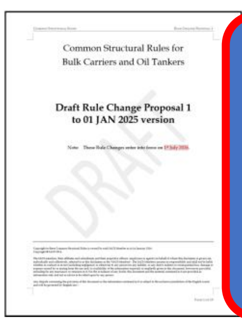


(2023) New Corrosion in CSR
- Ch.3, Sec.3 Corrosion additions
- Ch.13, Sec.2 Renewal Criteria

To be noted: new corrosion additions are NOT included in RCP 2025



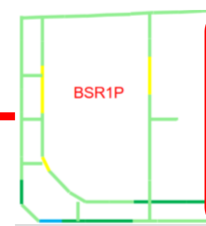
(23-24) New wave loads in CSR
- Use new wave scatter diagram
- Use the latest development in wave load calculations tools
- Linear statistical analyses with 200 ships



Common Structural Rules for Bulk Carriers and Oil Tankers

Draft Rule Change Proposal 1 to 01 JAN 2025 version

(2025) RCP 2025
- Ch.3, Sec.5 Limit States
- Ch.4, Sec.2, 3, 4 & 5 Wave loads
- Ch.9 Fatigue items
- Ch.XX Proposals to address unreasonably high impacts

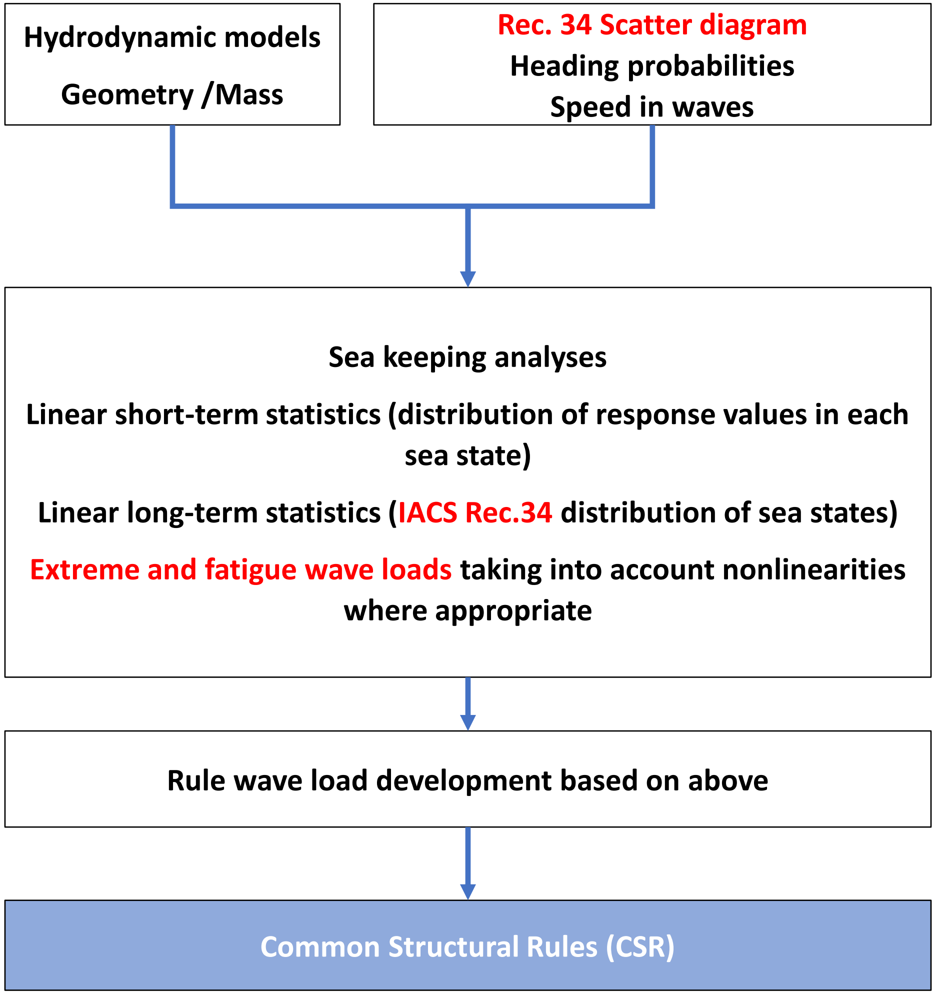


(23-24) Consequence Assessment
- S/W Implementation and cross-check
- Conduct CA with new wave loads
- Develop the CA reports as TB in CSR

(2026) CSR RCN 2025

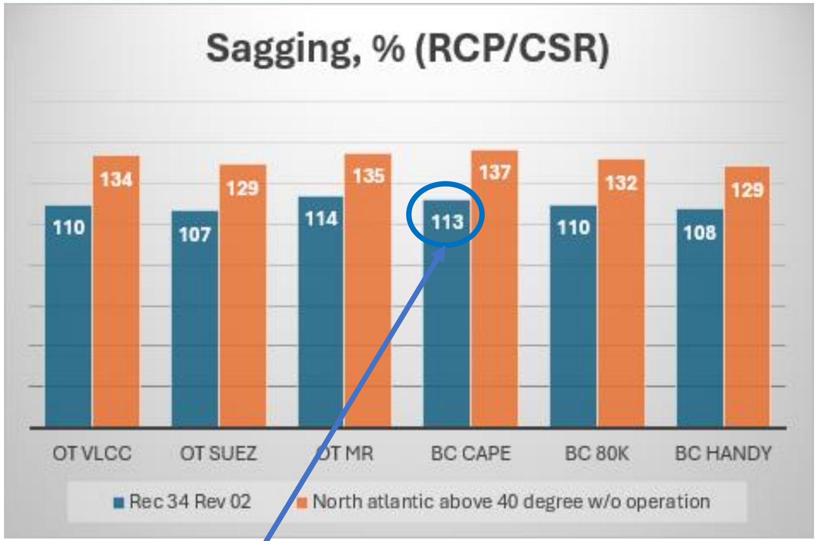
to be considered in RCP 2025

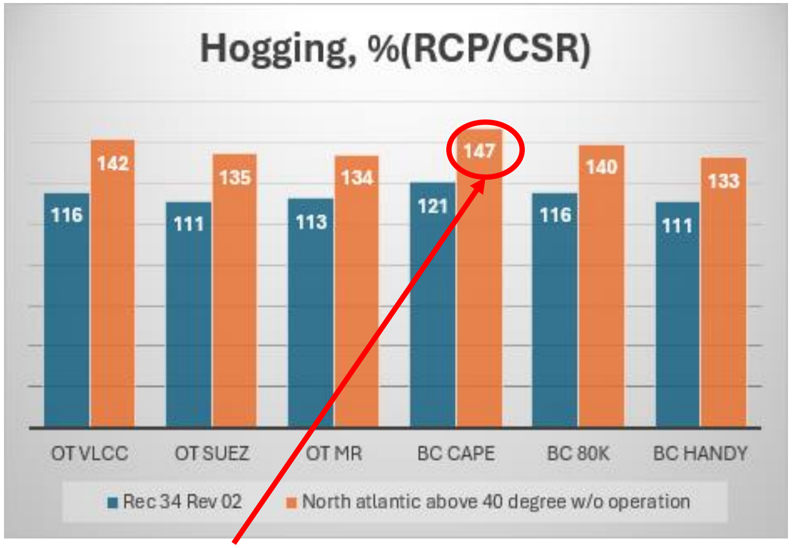
IACS Rec.34 and rule development (rule wave loads)



- **Rec. 34 acts one important element in the development of IACS CSR**
- **Rec.34 describes the standard wave data of the North Atlantic, which is considered and confirmed as the most severe sea area, but not as the "worst case sea state".**
- **The scatter diagram and associated wave spectrum, direction probabilities, vessels dimensions, speed and loading conditions form the input to the numerical analyses acting as basis for rule updates.**
- **Linear statistical analyses (~ 4 million evaluations)**
  - **1 scatter diagram, 2 loading conditions, 2 limit states, ~ 240 responses, ~ 20 EDWs and ~ 200 vessels**
- **Rule updates (design loads) based on results of above analyses.**

Consequence of Rec.34 Rev.2 - Wave bending moment
(also, consequence of not considering ship operation & sea areas 24 & 25)





$Z_{0.5tc}$ / Z_{req}= 98.5%

Blue: Based on Rec.34 Rev.2 compared to current CSR.
Orange: Based on Rec.34 Rev.2, but not considering ship operation & sea areas 24 & 25 compared to current CSR.

$Z_{0.5tc}$ / Z_{req}= 87%

Section modulus of vessels is to be increased significantly.

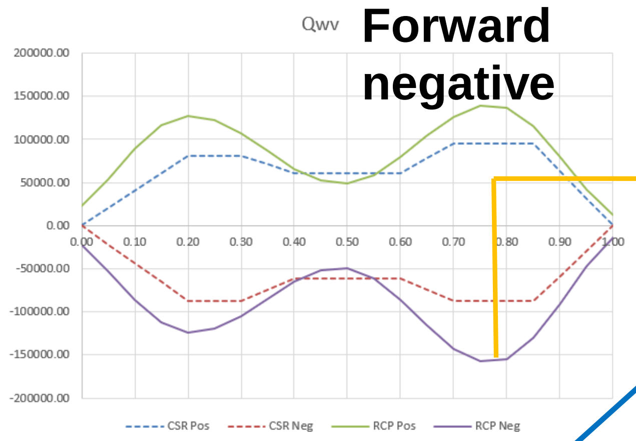
$Z_{0.5tc}$ = Section modulus based on 50% of corrosion addition
Z_{req} = Section modulus required

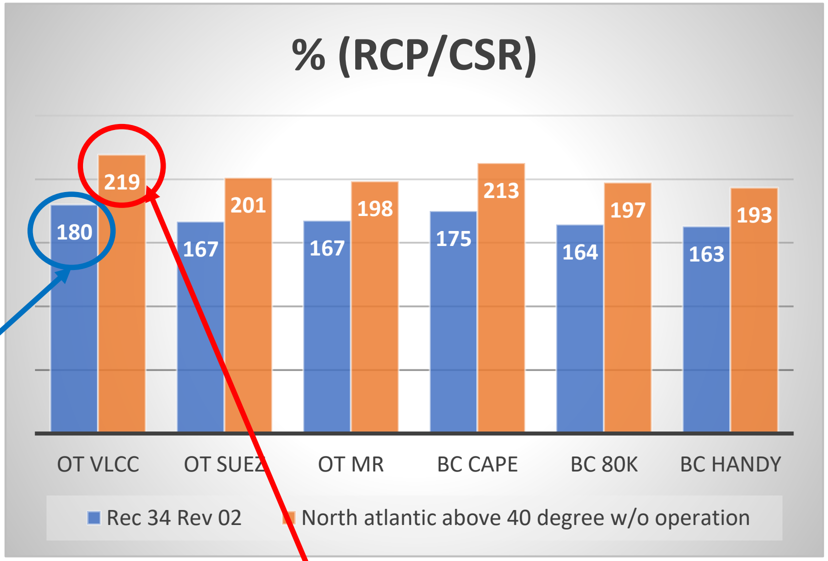
Rec.34 Rev.2 already results in **wave bending moment increased between 108% and 121%** with respect to the current CSR.
Excluding ship operation & sea areas 24 & 25, this increase will become even greater, **between 129% and 147%** with respect to the current CSR.

Excluding sea area 24 & 25 only (but considering ship operation), the increase would only slightly grow from typically 3% and up to 4.5% (depending on ship length) with respect to Rec.34 Rev.2 (e.g. in case of VLCC, 110% increase would become 115% increase with respect to the current CSR).

Consequence of Rec.34 Rev.2 - Wave shear force

(also, consequence of not considering ship operation & sea areas 24 & 25)





Total shear force increase to 133%

Total shear force increase to 150%

Total shear force = Permissible still water shear force + Wave shear force

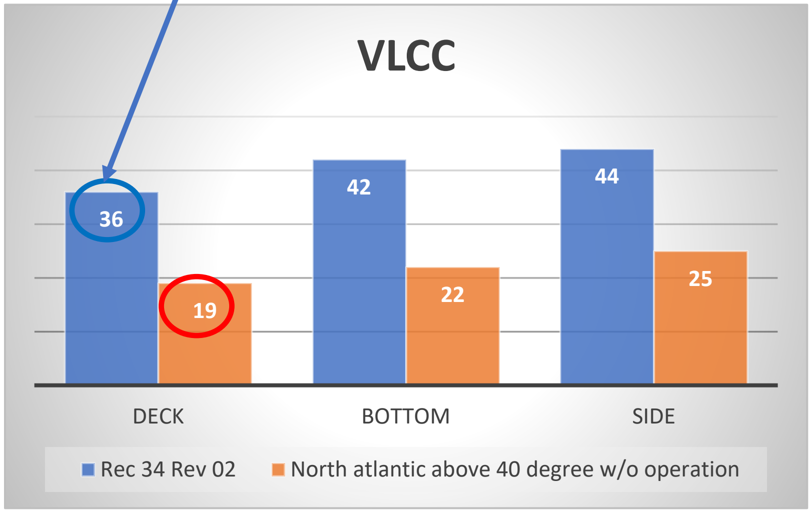
Blue: Based on the IACS Rec.34 Rev.2 compared to current CSR.
Orange: Based on IACS Rec.34 Rev.2, but not considering ship operation & sea areas 24 & 25 compared to current CSR.

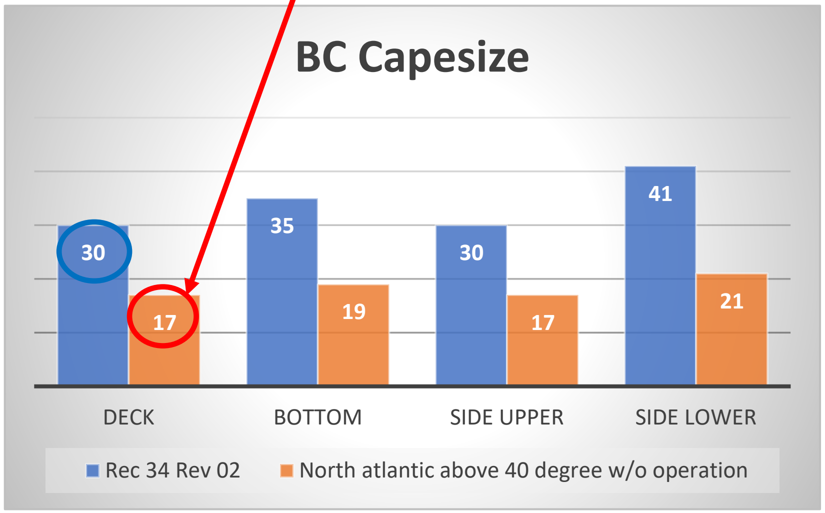
Consequence of Rec.34 Rev.2 - Fatigue life in years

(also, consequence of not considering ship operation & sea areas 24 & 25)

Wave induced fatigue loads experienced by 0.02% of the world fleet, i.e less than 20 vessels

Fatigue loads far above what any ships in the world fleet have experienced



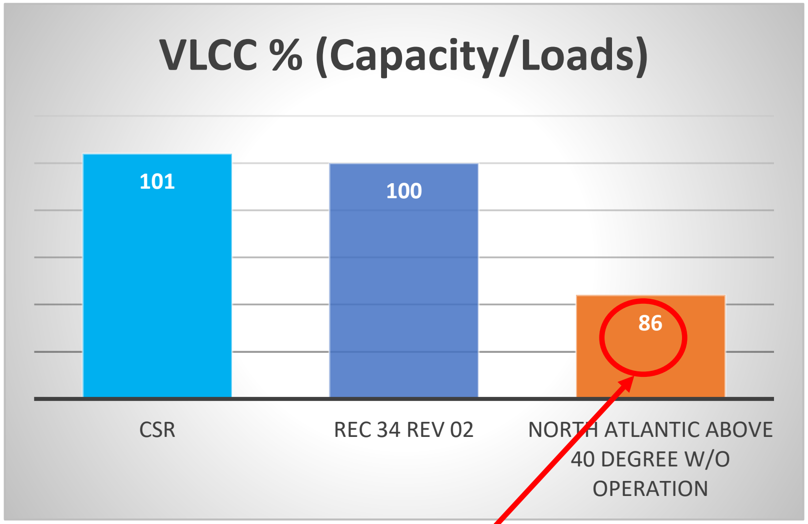


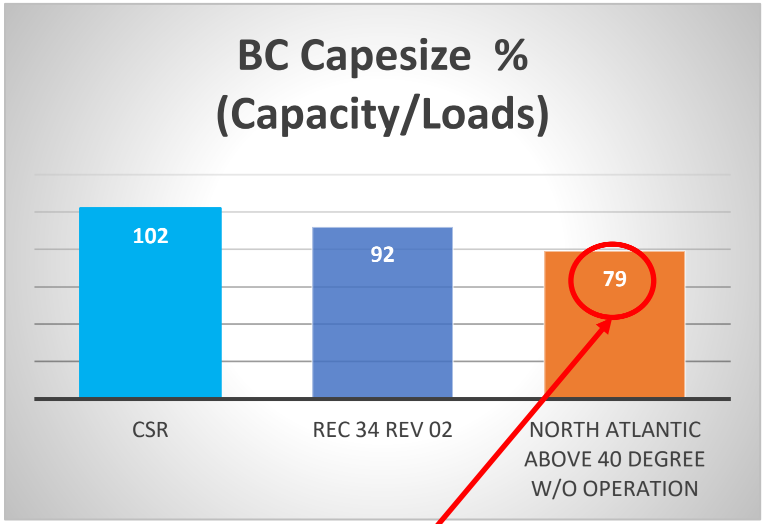
Significant increase of hull girder section modulus would be required
Detail improvements will not be sufficient

Blue: Based on the IACS Rec.34 Rev.2 compared to current CSR.
Orange: Based on IACS Rec.34 Rev.2, but not considering ship operation & sea areas 24 & 25 compared to current CSR.

Consequence of Rec.34 Rev.2 considering ship operation, but without sea areas 24 and 25: in general, it will be between the figures above, but closer to Rec.34 Rev.2.

Consequence of Rec.34 Rev.2
- Hull girder ultimate strength
(also, consequence of not considering ship operation & sea areas 24 & 25)





Rec.34 Rev.2 already results in **more severe hull girder ultimate strength check** with respect to the current CSR.
Excluding ship operation & sea areas 24 & 25, this check will become even much more severe with respect to the current CSR.
No solution with local improvements, e.g. stiffener type/size.

Conclusion from preliminary application of RCP loads based on Rec.34 Rev.2

Consequence of implementing new loads into existing ship designs:

- **increased wave vertical bending moments peak in midship region, decreased in fore region and almost same in aft region due to modified shape of long. distribution**

  Particular Hog increase at Tsc, expecting **increase of rule required section moduli and buckling usage factors with possible scantling impact** (bending, buckling and ultimate strength)

- **Increased Wave vertical shear force peaks around 0.25L and 0.75L, slighlty decreased in midship region due to modified shape of long. distribution**

  Expecting **increase of rule required thickness and buckling usage factors of vertical members with possible scantling impact** (shear and buckling)

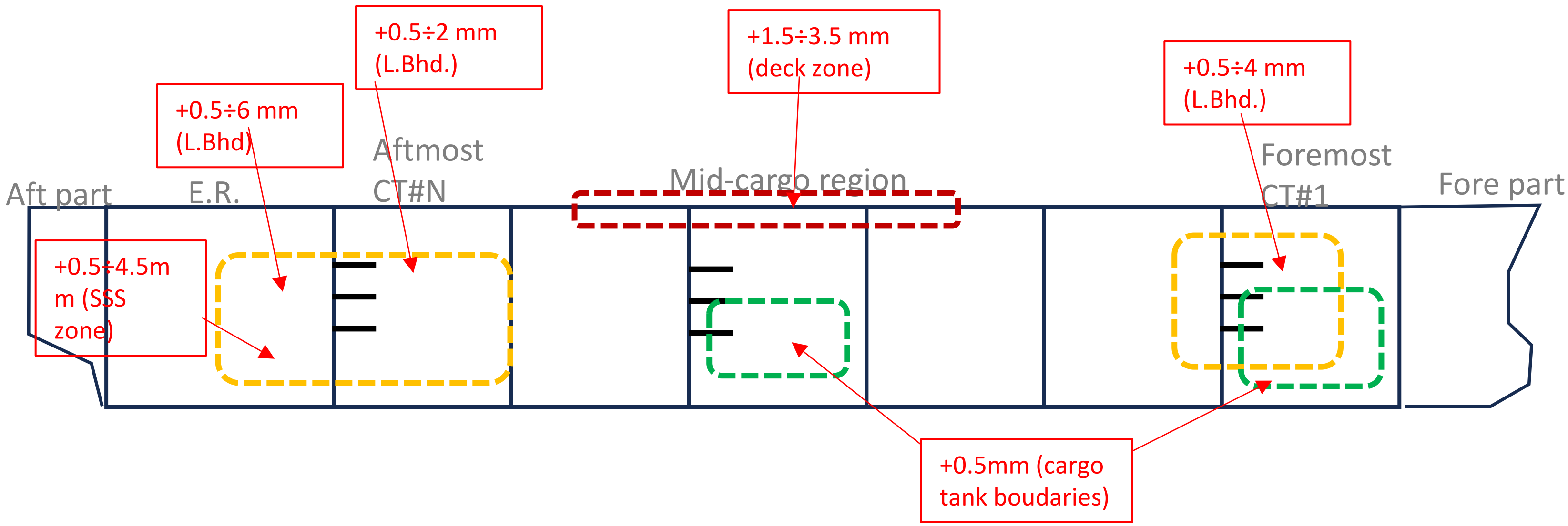
- **Values of the pressures at similar levels, more continuous external wave sea-pressure distribution CSR some slighlty increased internal loads**

  Possible scantling impacts in cargo boudaries, however not expecting significant;

  Fatigue: expecting fatigue lives comparable/slight increase

Rec.34 Rev.2 based CSR loads Hull increased demand (OT)

Larger Oil Tankers



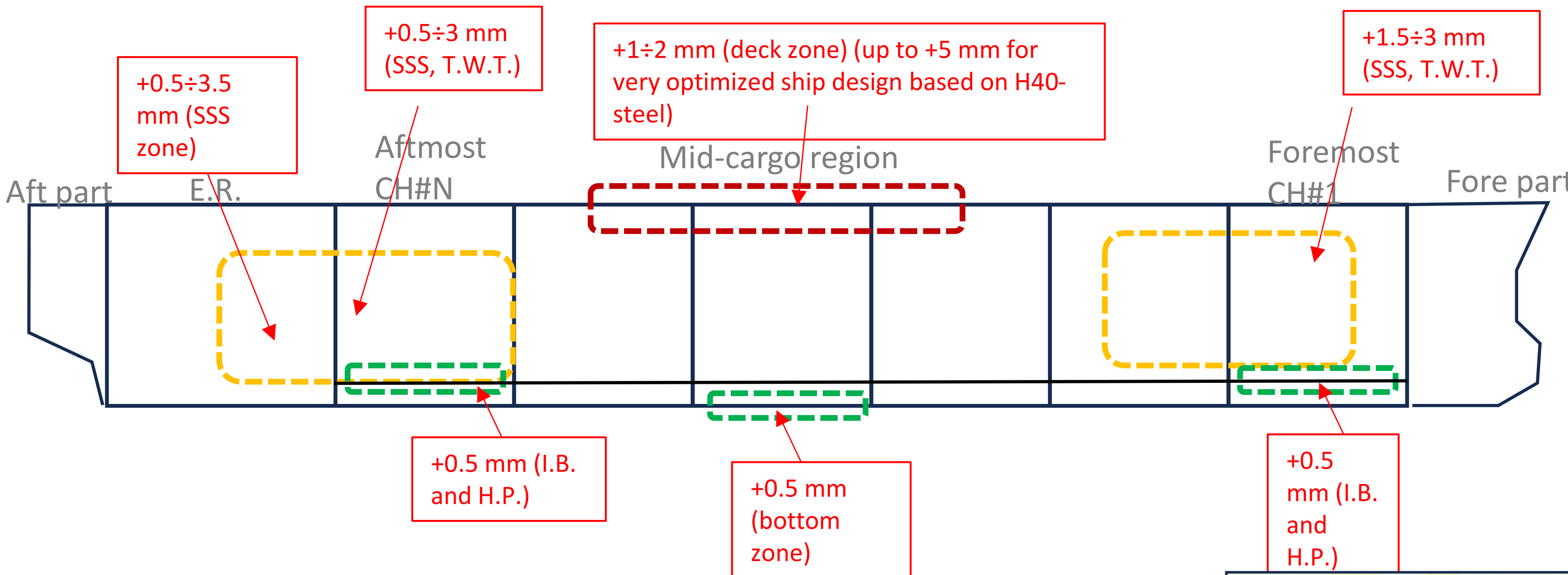
Scantling increases of 0.5 to 6 mm in the following ship's areas:

- Hull Girder Bending deck zone
- Hull Girder Shear strength inner longitudinal bhd, particularly i.w.o. transverse bulkheads
- Internal loads on cargo tanks Envelope
- Buckling Horizontal stringers
- Buckling bottom zone

Scantling increase in mm are based on existing **VLCC** ship designs and it is rough estimate (by simple plate thickness increase till satisfaction of the requirement)

Rec.34 Rev.2 based CSR loads Hull increased demand (BC)

Bulk Carriers



Scantling increase in mm are based on existing **Capesize** designs and it's rough estimate (by simple plate thickness increase till satisfaction of the requirement)

Scantling increases of 0.5 to 5 mm in the following ship's areas:

- Hull Girder Bending deck zone
- Hull Girder Shear strength single side shell, particularly i.w.o. transverse bulkheads
- Internal loads on cargo hold's bottom (hopper and Inner bottom)
- Buckling bottom zone

Conclusion

- Consequence of Rec.34 Rev.2 on wave loads:
  - **Rec.34 Rev.2 will result in an increase of wave loads,** in particular hull girder bending moment and shear force, (e.g.7-21% increase of wave bending found for vessels checked), as well as local loads and pressures in revised CSR
  - **Not considering sea areas 24 & 25 would cause further increase of wave loads** and delayed implementation of revised CSR
  - **Not considering ship operation and sea areas 24 & 25 would cause strengthening far beyond what the Industry have experienced** and **would lead to a completely new class of ships** creating a two-tier market.
- IACS will update Rec.34 to contain more detailed information about the application together with assumptions and the statistical modelling of the synchronization process adopted to derive the wave data, accompanied by a more comprehensive technical background.
  - **The updated version of Rec.34 will not change the methodology or the actual scatter diagram.**
- Future IMO GBS audit on IACS Rec.34 will be carried out in conjunction with that of the consequential rule changes in CSR.
- IACS' consultation with Industry on rule change proposal will continue.