Presentation on CSR updates

INTERCARGO's Technical & Executive Committee meeting

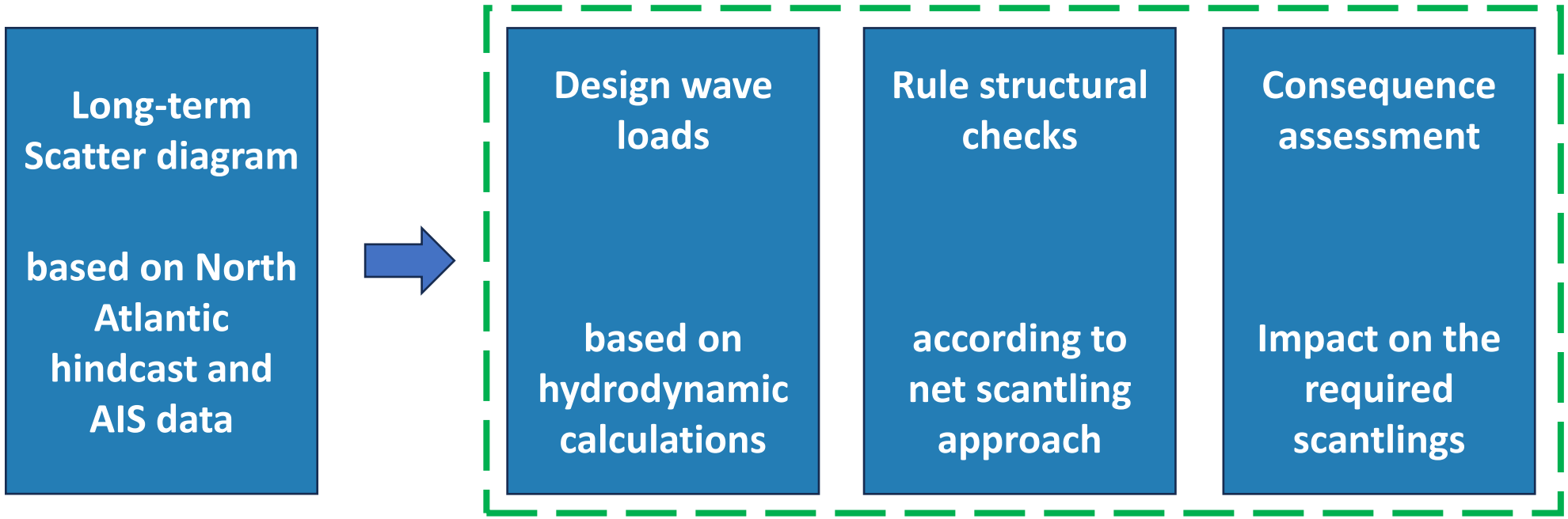
Hyungmin CHO

IACS Hull Panel Chair

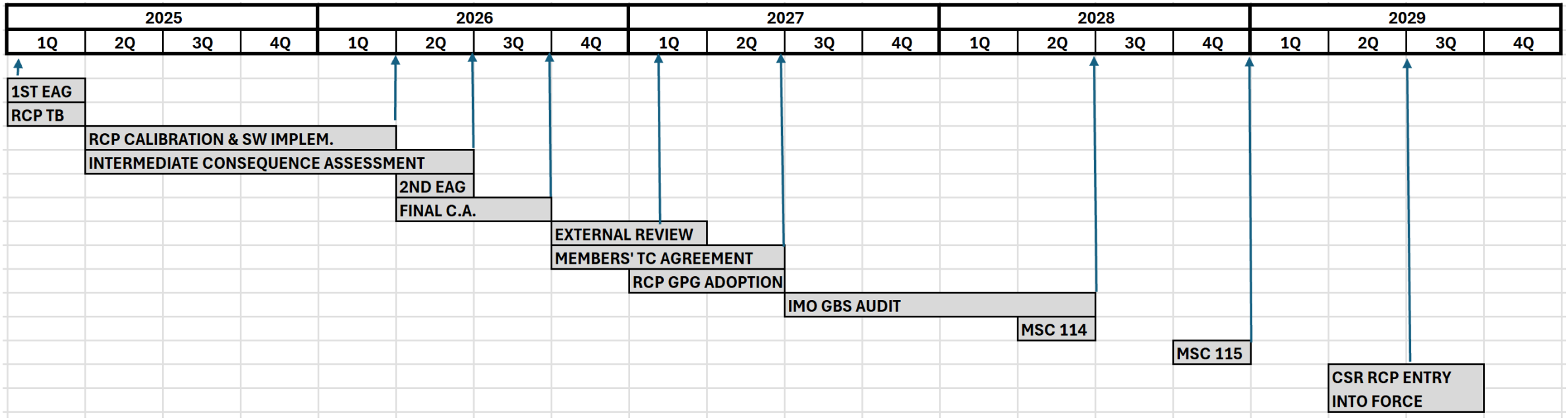
12-13 May 2025

Rule Change Proposal

- The GBS auditors **recommended in 2016** that more detailed information would be needed to demonstrate that the wave data used in the rules properly represent North Atlantic conditions.
- IACS took this opportunity to carry **out a comprehensive review of the CSR**, benefiting from significant advances in hydrodynamic and structural calculations that can now be better integrated into the rules to enhance transparency. The **Rule Change Proposal (RCP)** includes:



CSR RCP Timeline



RULE CALIBRATION, SW DEV. & CONSEQUENCE ASSESSMENT

EXTERNAL REVIEW & RCP ADOPTION

IMO GBS AUDIT & CSR RCP ENTRY INTO FORCE

Why are IACS updating wave loads ?

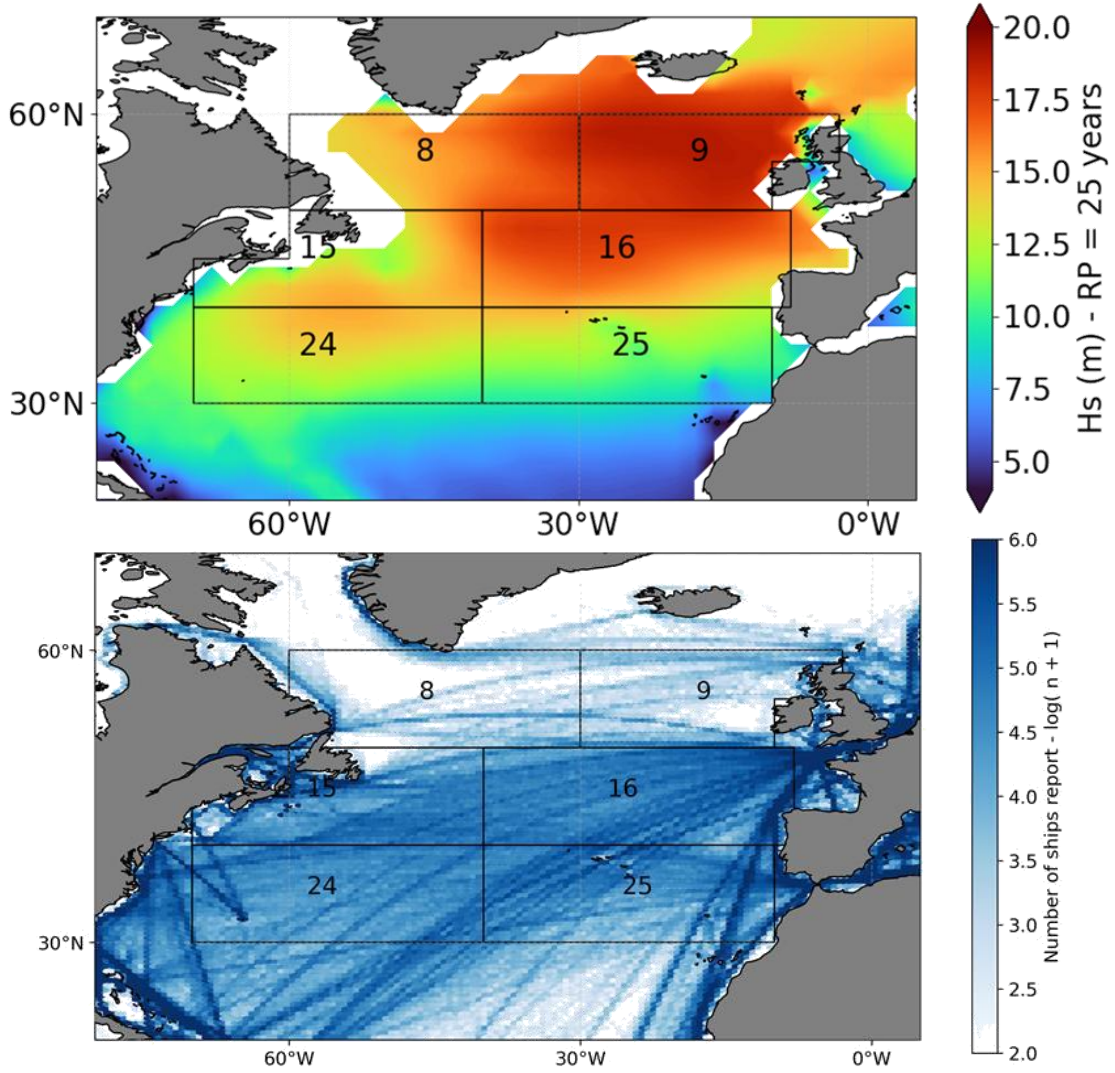
- Current CSR wave loads are safe
- The description of the North Atlantic environment in Rec.34 Rev.1 is inaccurate/obsolete
- Lack of consistency between CSR and Rec.34 Rev.1 wave scatter diagram
- This prompted a revision of Rec.34 Rev.2
- Most of criteria related to failure modes (e.g. yielding and buckling) will be kept unchanged
- Hull girder wave bending moments and wave shear forces need to be improved
- The RCP will lead to enhanced strength requirements, i.e. the structural safety will be increased

North Atlantic conditions

Hindcast wave data validated with satellite altimeter and buoy measurements

synchronized with

Operational data ships' position, speed and heading using AIS database



The wave scatter diagram is a statistical description of sea states encountered by merchant ships in the North Atlantic for ship classification purposes

North Atlantic starts at 30°N or 40°N ?

- Initially the new wave scatter diagram was developed for various areas including the North Atlantic above 40°N (same area as used in Rec.34 Rev.1)

- Fatigue loads were evaluated for more than 40.000 vessels based on AIS and hindcast wave data and it was concluded that based on design wave environment, north of 40°N, the fatigue loads became higher than any ships have experienced during the 7 years period data collection (2013-2020)

- By extending the North Atlantic area down to 30 N, the corresponding wave loads for fatigue assessment become more representative, and have been encountered by 0.02% of the world fleet during the 7-year period.

- A wave scatter diagram derived for the 40°N envelope, may be relevant as a conservative basis for ultimate strength. However, for fatigue this wave environment will be too high since no vessels in the data set have experienced a wave fatigue load level consistent with this wave scatter diagram.

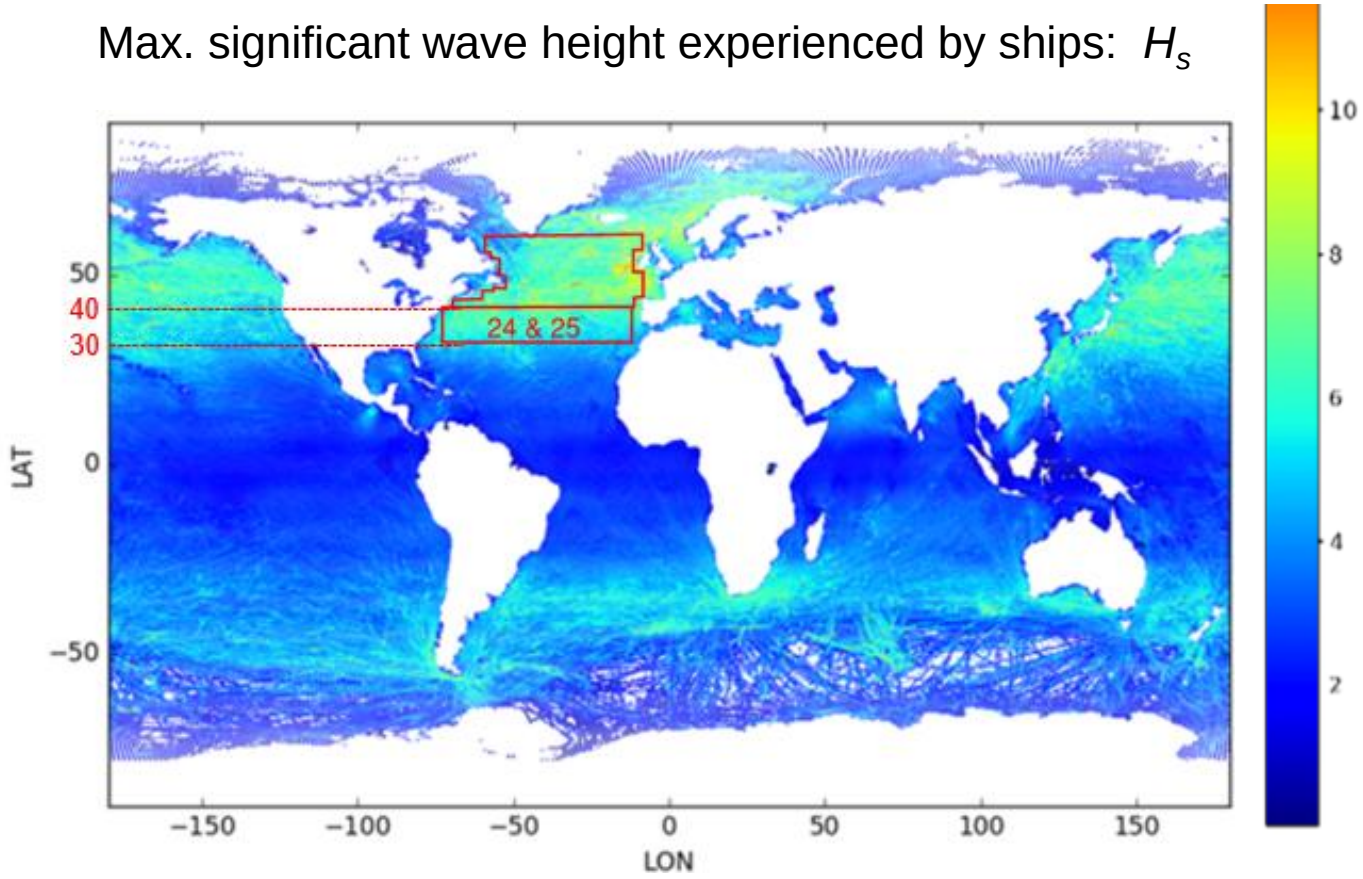
North Atlantic starts at 30°N or 40°N ?

- Hull girder wave rule loads based on Rec.34 Rev.2, north of 30°N, **are higher** than current CSR, with max. values :
  - Wave bending, sag: ~ 3-13% increase
  - Wave bending, hog: ~ 3-21% increase
  - Wave shear force: ~ 64-80% increase

- Without areas 24 & 25, north of 40°N, hull girder wave rule loads will be typ. 4-5% **higher** than those for north of 30°N, with max. values relative to current CSR:
  - Wave bending, sag: ~ 11-18% increase
  - Wave bending, hog: ~ 16-26% increase
  - Wave shear force: ~ 69-88% increase

By extension to 30°N, i.e. including areas 24 & 25, the number of recordings was increased more than twice compared with the more northern envelope

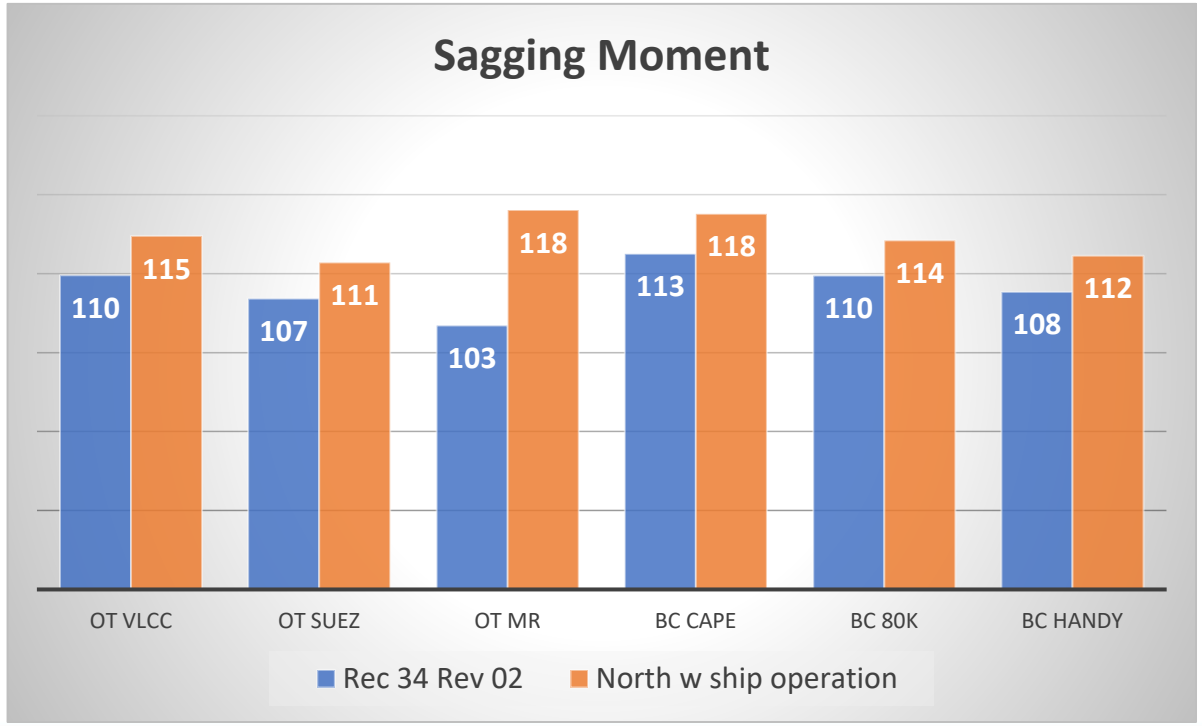
Max. significant wave height experienced by ships: H_s

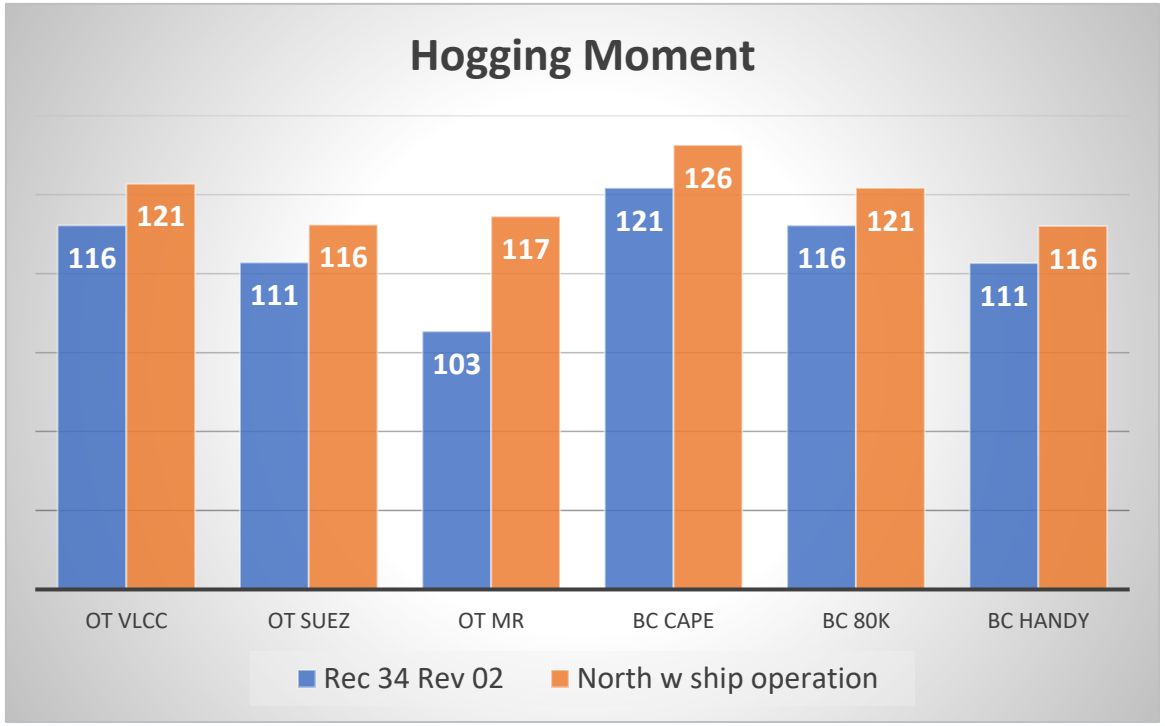


Wave bending moment comparison

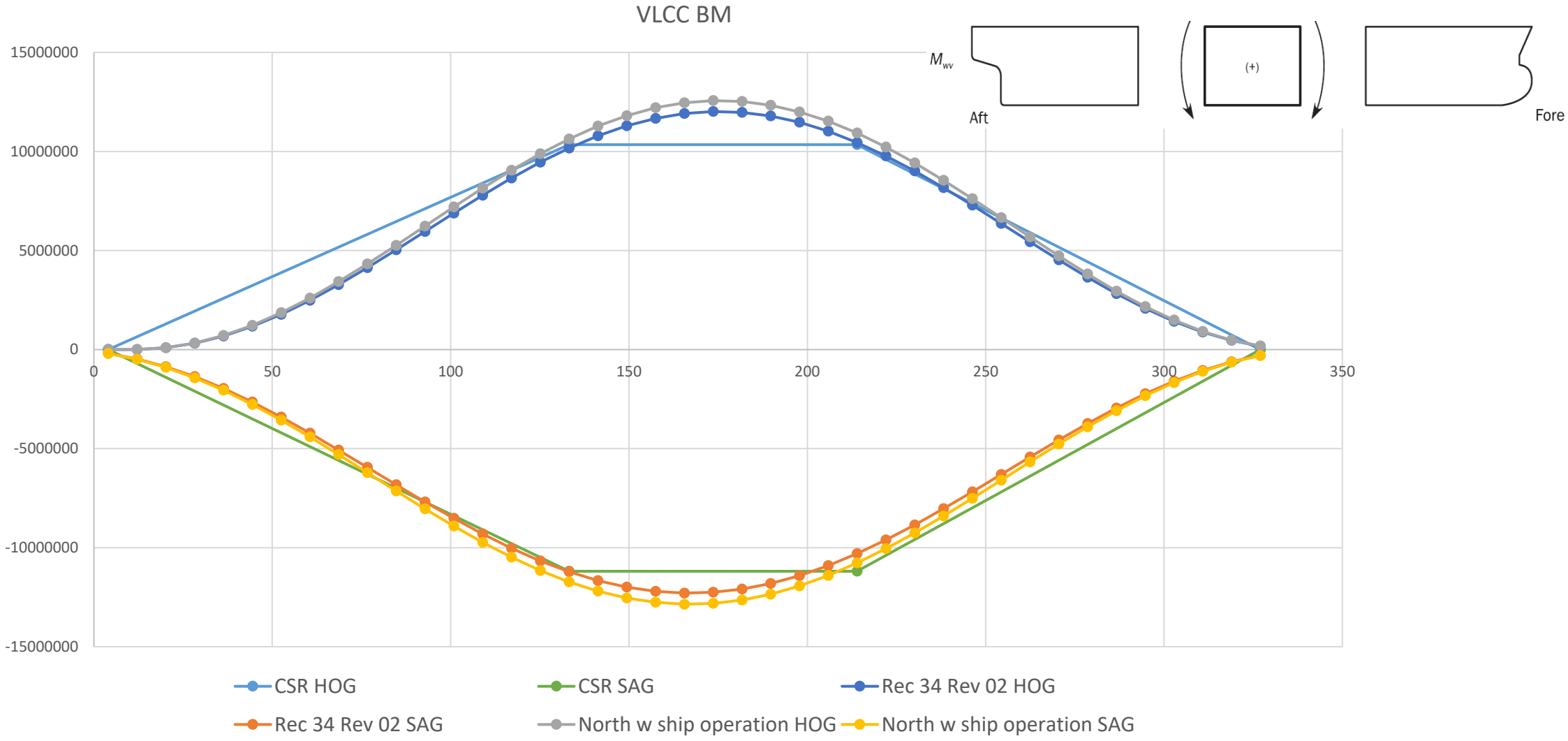
Max. wave bending moment with different options / CSR wave bending moment, in %
Current CSR = 100%

- **Rec 34 Rev 02, 30°N with operation (AIS+Hindcast)**
- **40 °N with operation (AIS+Hindcast)**

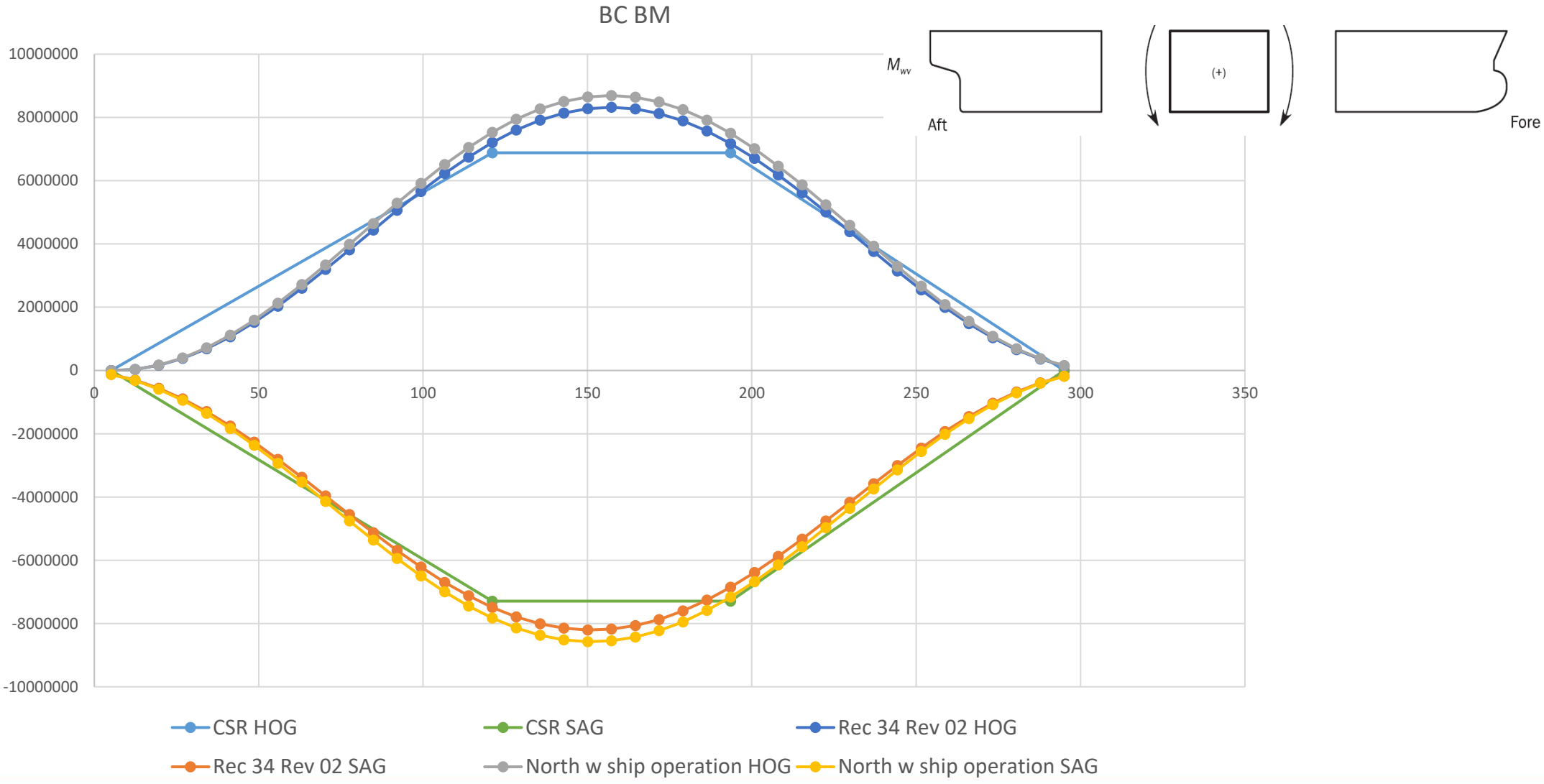




VLCC - Wave bending moment distribution



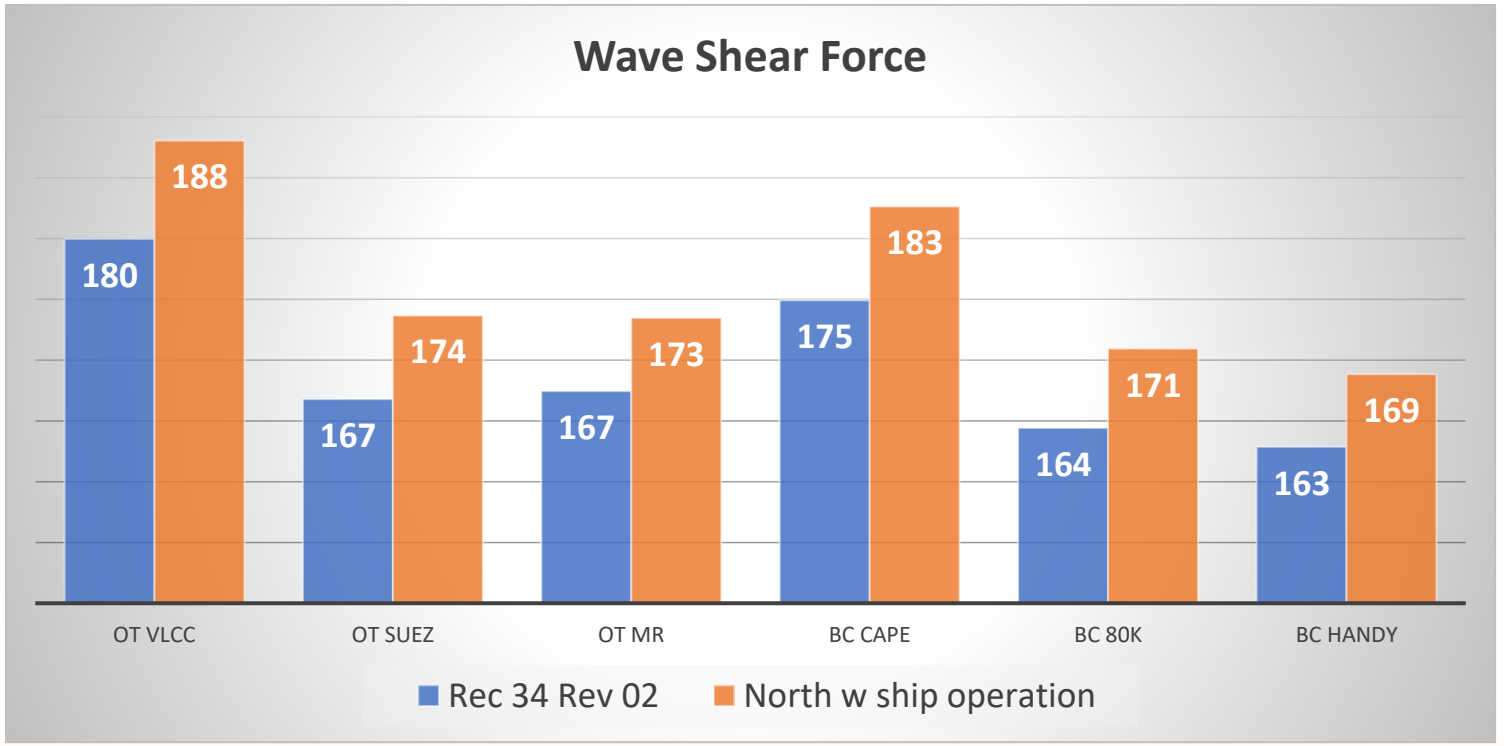
BC Cape - Wave bending moment distribution



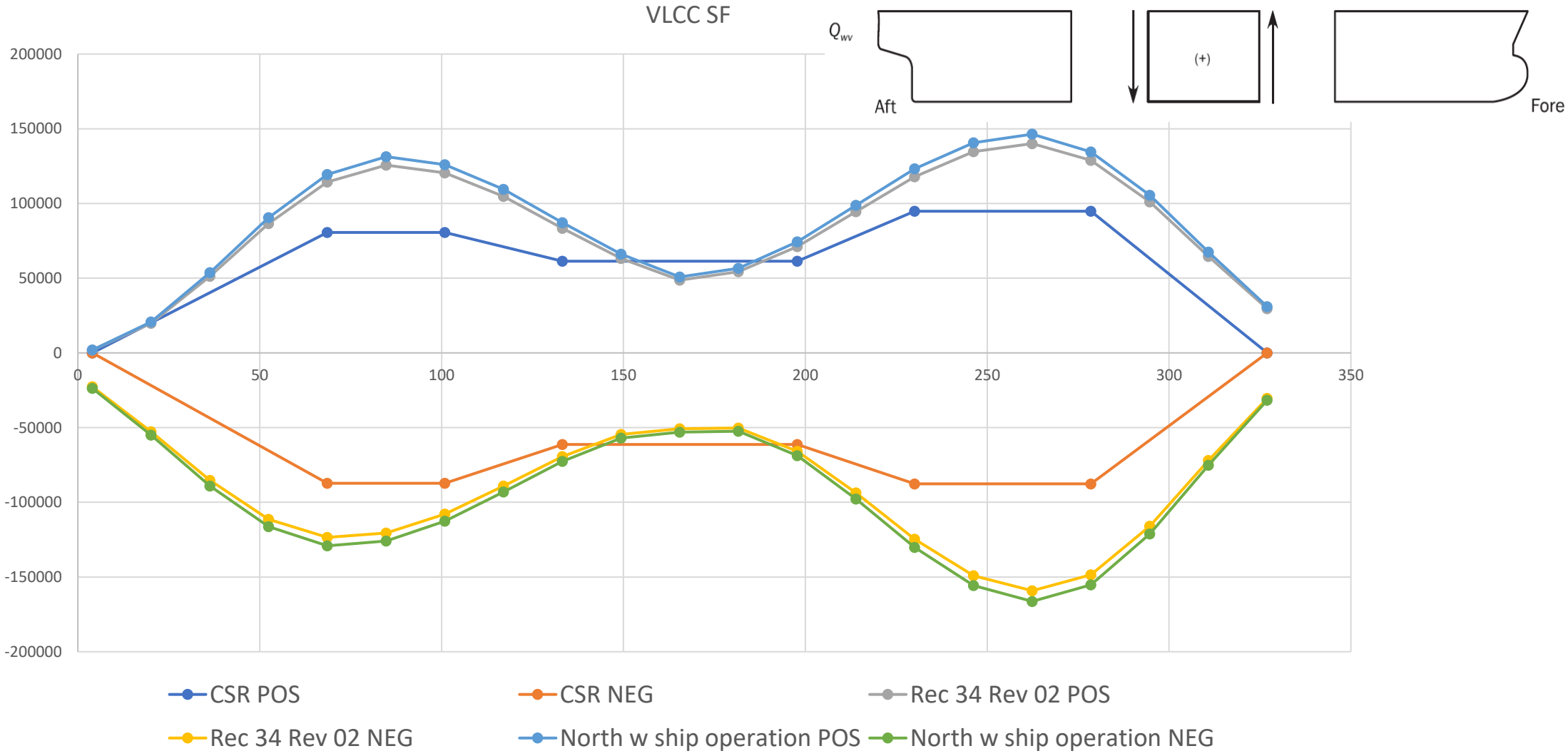
Wave shear force comparison

Max. wave shear force with different options / CSR wave shear force, in %
Current CSR = 100%

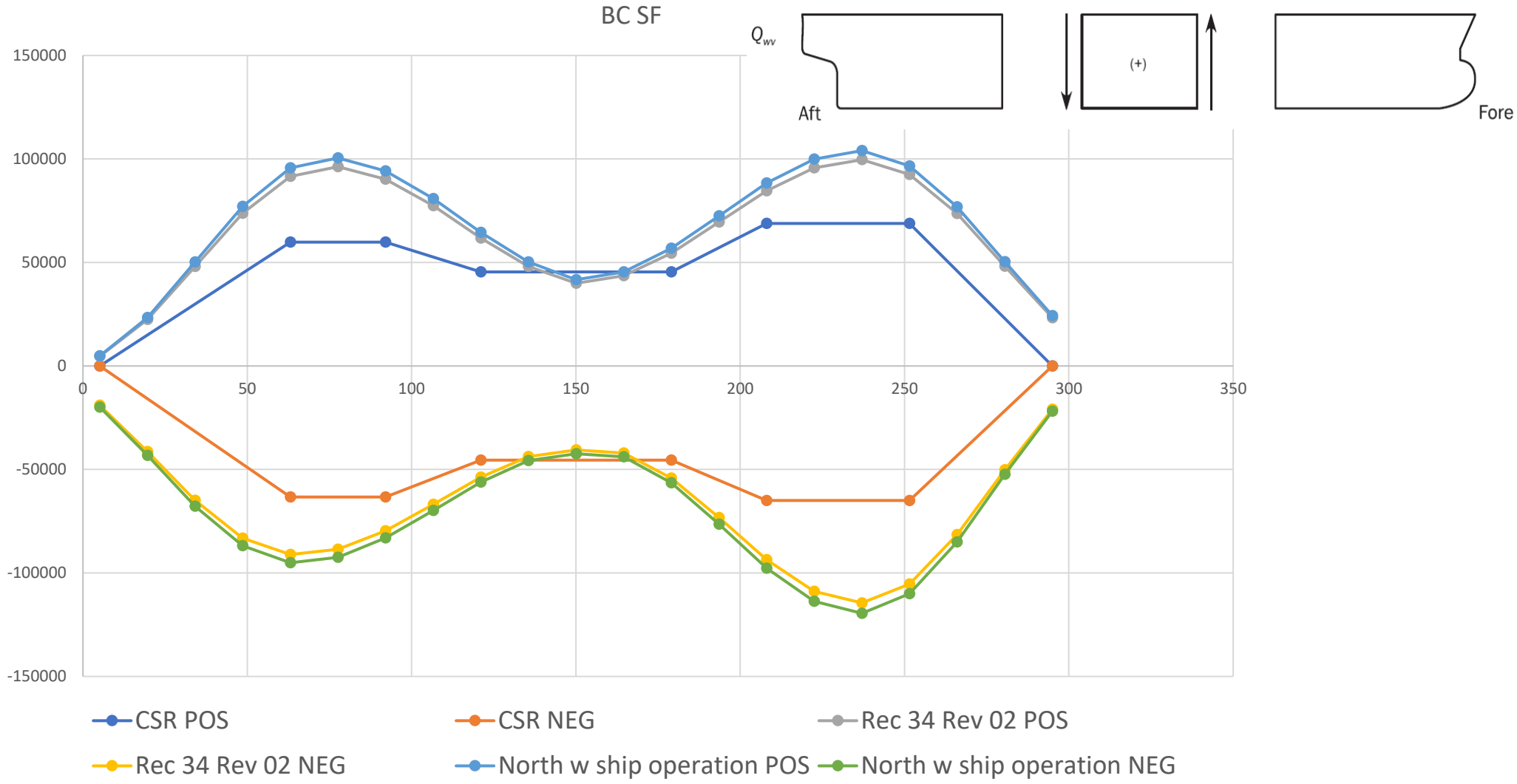
- **Rec 34 Rev 02, 30°N with operation (AIS+Hindcast)**
- **40 °N with operation (AIS+Hindcast)**



VLCC - Wave shear force distribution



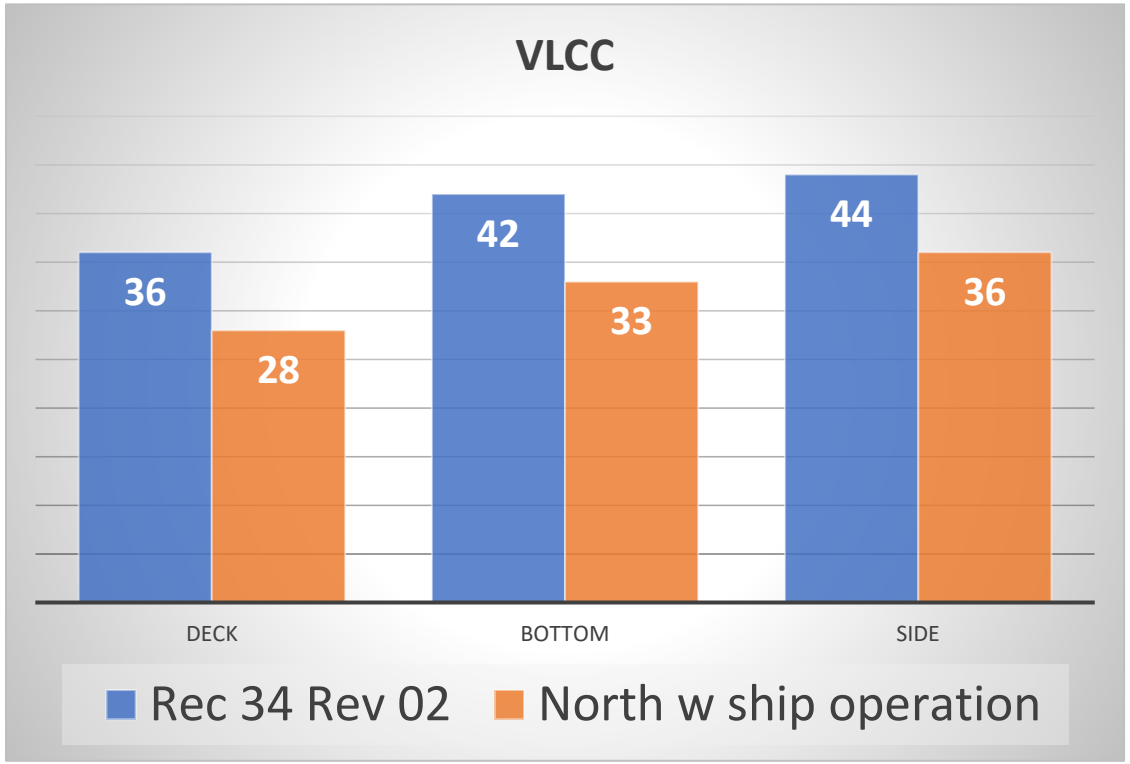
BC Cape - Wave shear force distribution

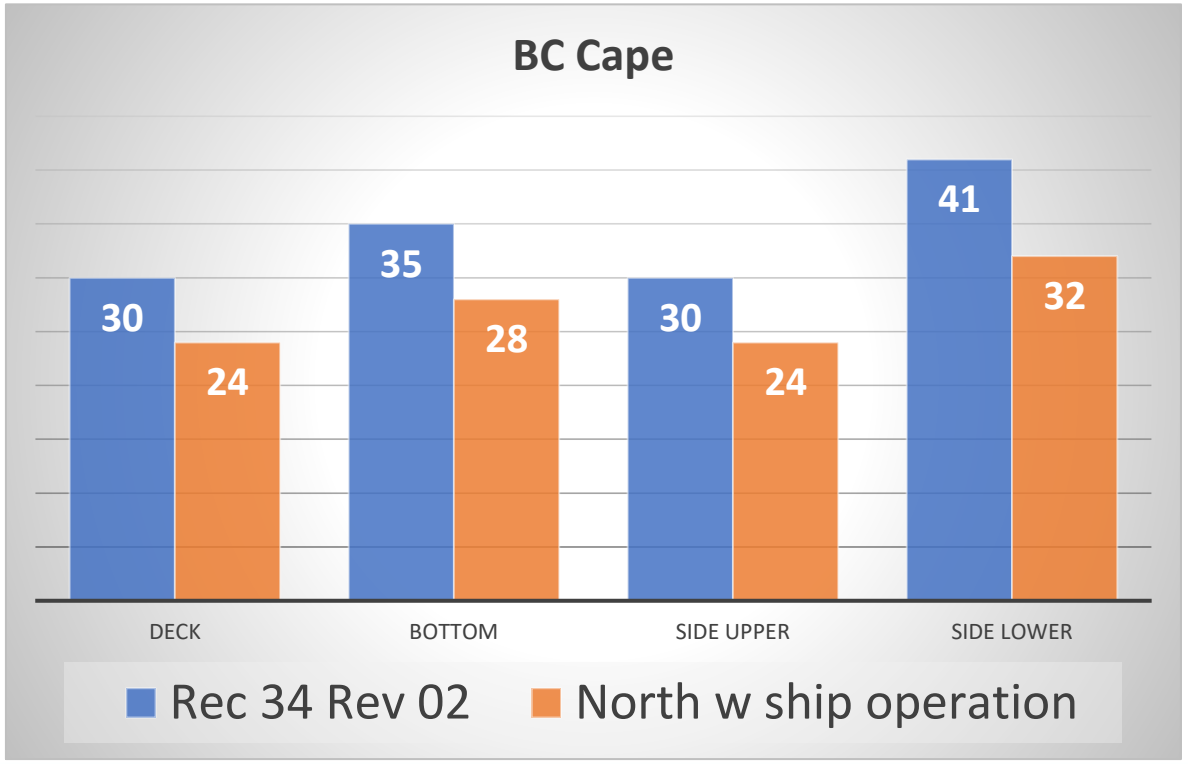


Fatigue life comparison in years

Acceptable ≥ 25 years

- Rec 34 Rev 02, 30°N with operation (AIS+Hindcast)
- 40 °N with operation (AIS+Hindcast)

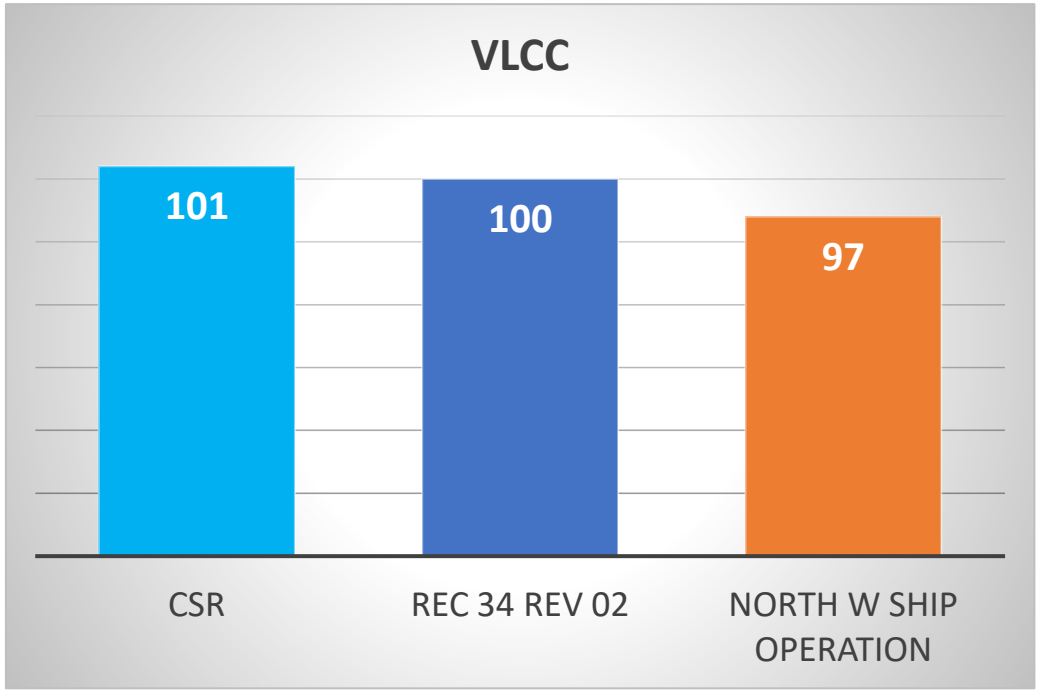


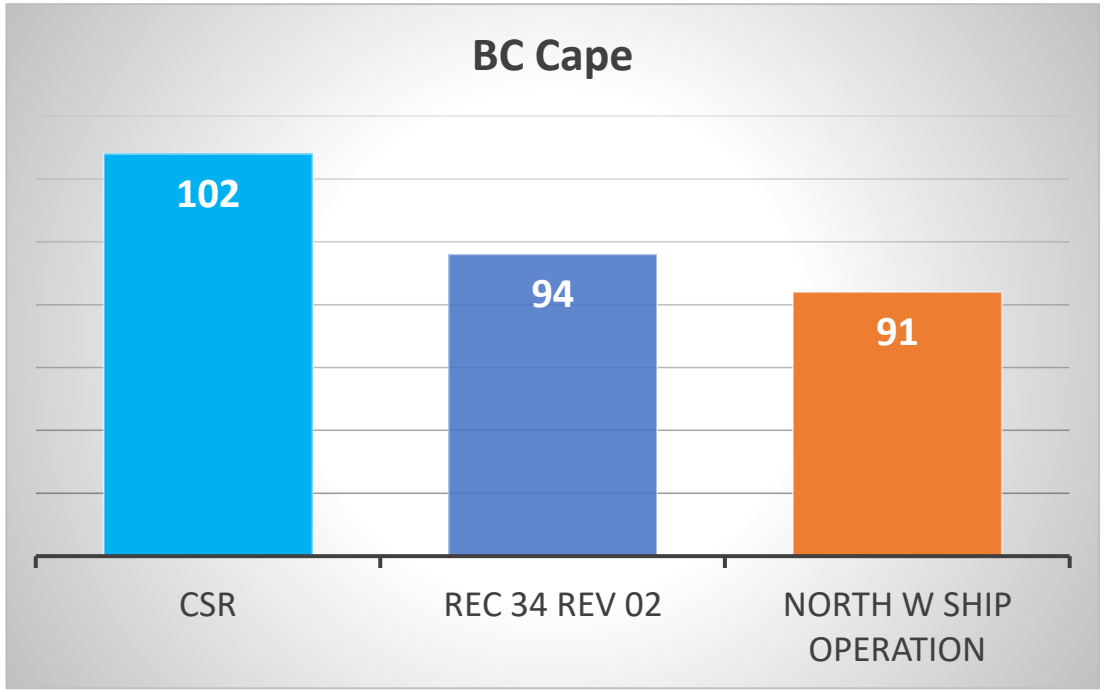


Hull girder ultimate strength

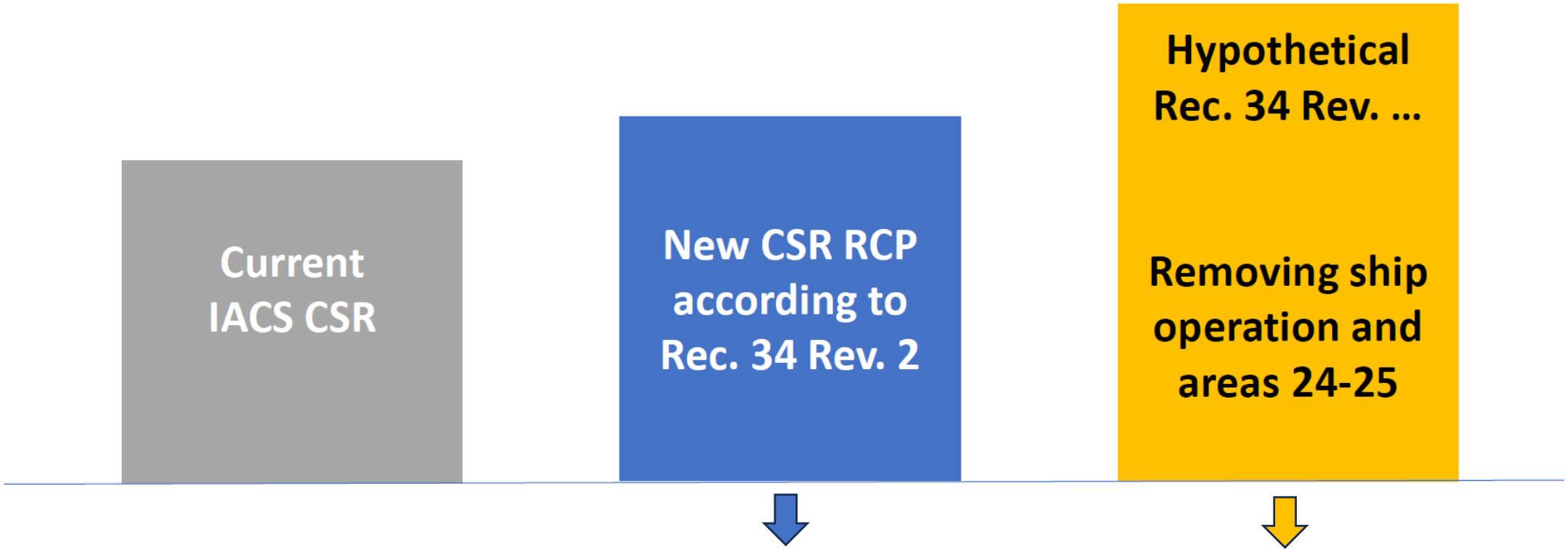
Moment Capacity/Loads, margin in % with current CSR method
Acceptable ≥ 100%

- Rec 34 Rev 02, 30°N with operation (AIS+Hindcast)
- 40 °N with operation (AIS+Hindcast)





Hull Girder Wave Loads



Hull girder wave load increase compared with current CSR		
Max. wave bending moment	10% to 20% increase	30 to 50% increase
Max. wave shear force	65% to 75% increase	100 to 115% increase

Technical comparison RCP with CSR Jan 2024

Rule Criteria	Stillwater loads	Wave loads	Capacity model	Acceptance criteria
Hull girder section modulus [1)]	No change	+ 3-21%	No change	Ongoing
Hull girder buckling	No change	+ 3-21%	No change	No change
Hull girder shear [2)]	No change	+ 64-80%	Ongoing	Ongoing
Cargo area FEA – yield strength	No change	Increased [5)]	No change	No change
Cargo area FEA – buckling strength	No change	Increased [5)]	No change	No change
Local strength plate/stiffener	No change	Increased [5)]	No change	No change
Fatigue [3)]	No change	Reduced	No change	No change
Hull girder ultimate strength [4)]	No change	+ 3-21%	Ongoing	Ongoing

1) This criteria is an industry standard, not linked to a particular failure mode.
2) This criteria is also an industry standard. Needs adjustment to avoid unreasonable scantling increases, e.g. shear force correction method need updating.
3) Current load scaling factors will be removed. A new hull girder vibration factor reflecting springing will be applied to the vertical wave bending moment.
4) Changes needed to account for different probability distribution for loads.
5) Hull girder loads increase. Wave pressures and accelerations/motions are in general equivalent or increased but reductions are also observed.

CSR information

More detailed information can be found at the following links to IACS website :

- **General overview:**

https://iacs.org.uk/resolutions/common-structural-rules

- **Webinar on CSR**

https://iacs.org.uk/resolutions/common-structural-rules/webinar-discussion-on-iacs-rec-34-rev-2

- **CSR FAQ:**

CSR Review: FAQ Archives - Safer and Cleaner Shipping - IACS