

WLNG FST Engineering Completion

WLNG FST Extreme Weather Analysis

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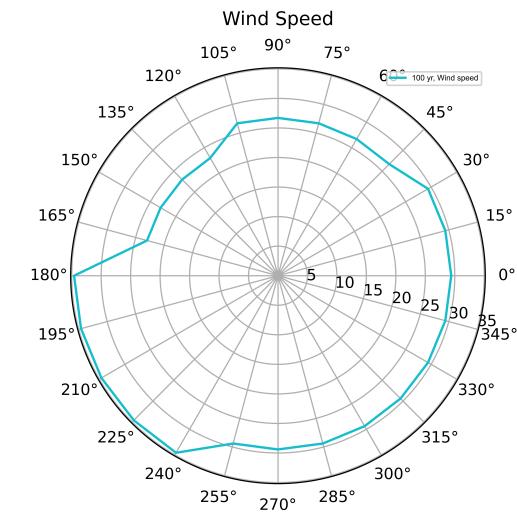
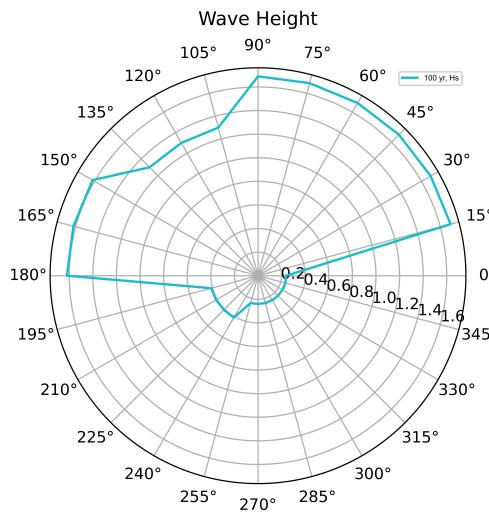
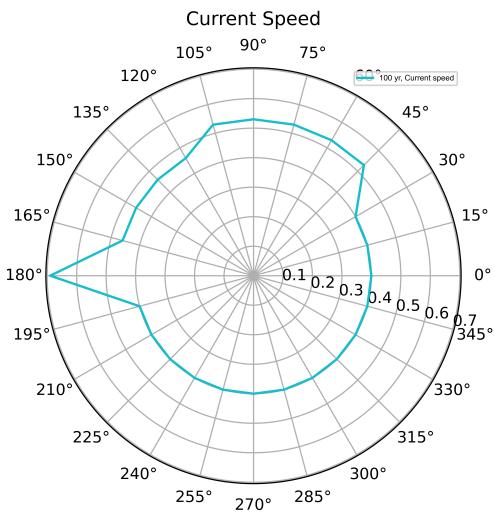
Introduction

- FST analysis for WLNG

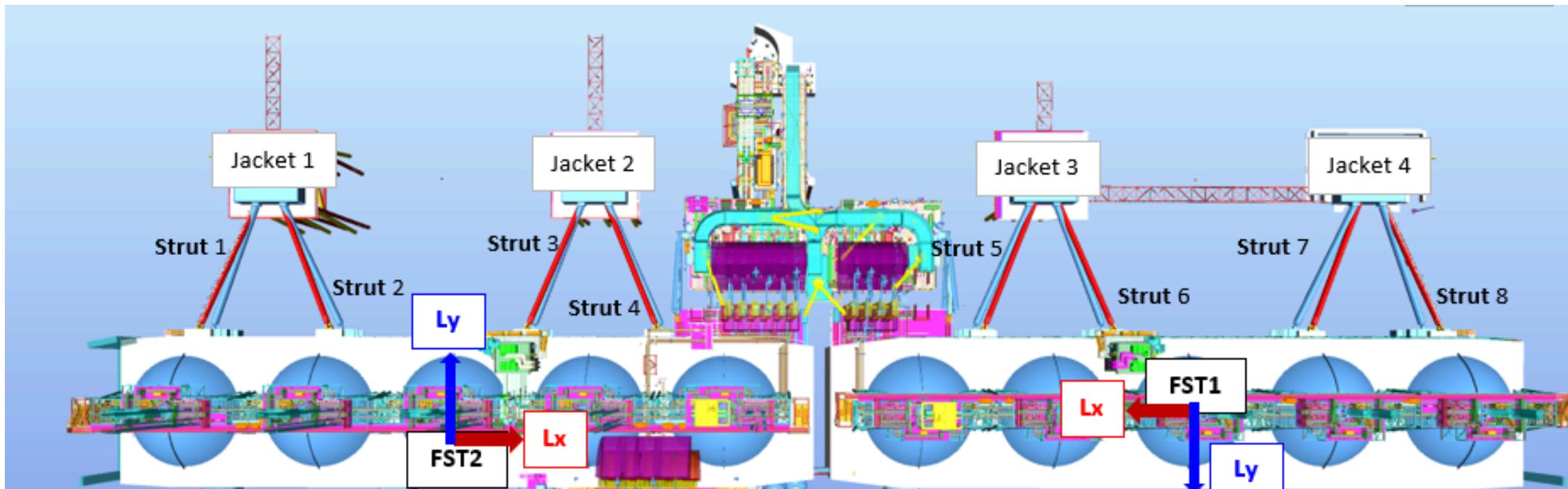
Design Data

Analysis Methodology

Design Data - Environment



FSTs Only, General Arrangement



- strut, jacket and FST numbering shown
- FST local axes shown

Methodology

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Methodology - Analysis

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- TBA

Methodology - Result Interpretation

- Timetrace plots ? actual values (no data manipulation)
 - Strut positive tension is tension and negative is compression i.e. axes independent values
 - Jacket forces are in global X and Y direction
 - FST forces are in FST local axes
- Radial/rose plots - ONLY positive values used
 - Objective:
 - For understanding directional trend.
 - The increase/decrease/reversals help determine the max forces.
 - Static values: absolute values
 - Dynamic values: absolute maximum i.e. max (abs(max), abs(min))

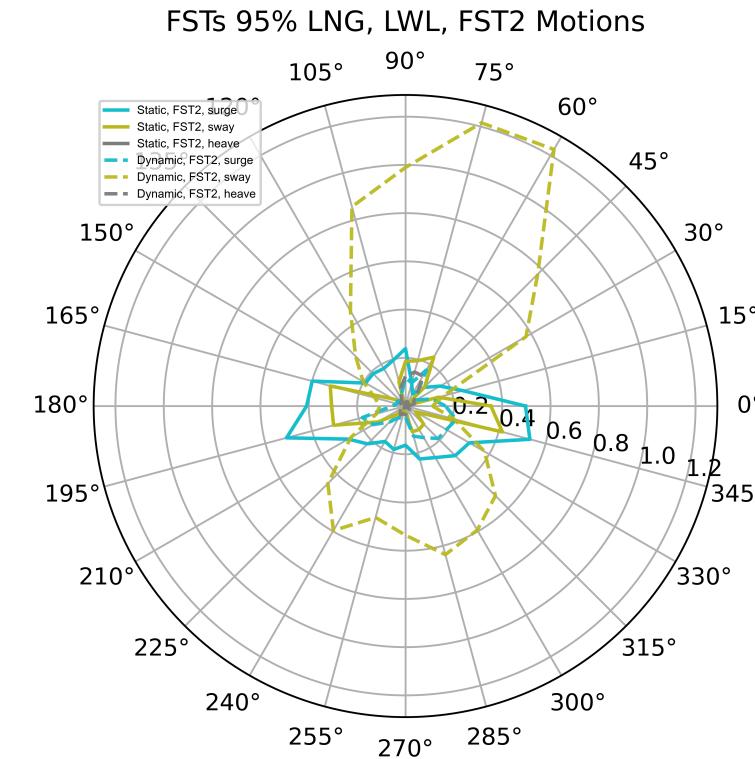
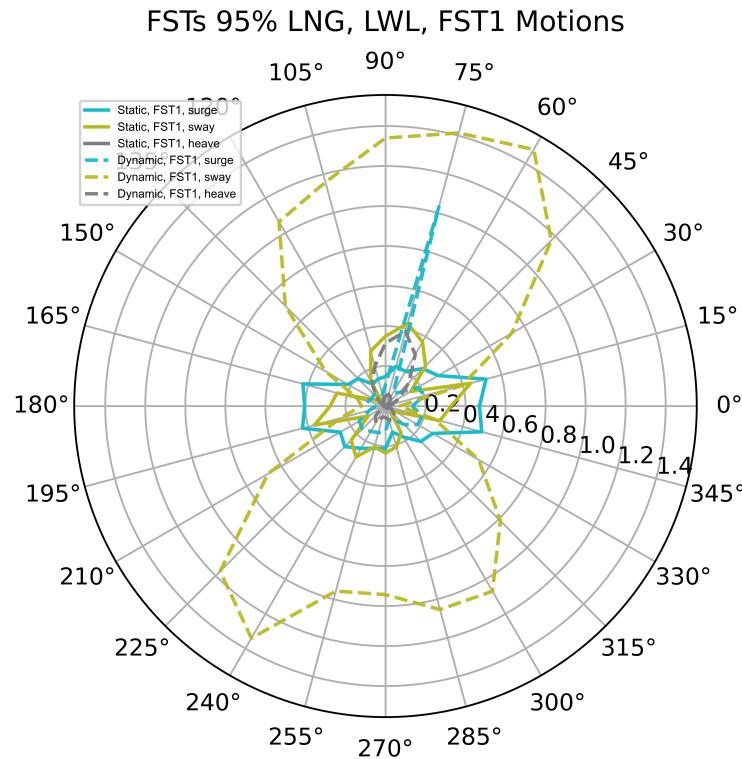
- Applicable details will be added to each slide

100 year Analysis Results

FST Motion Response

FSTs 95% LNG, 100yr, LWL - FST Surge and Sway, Directional Response

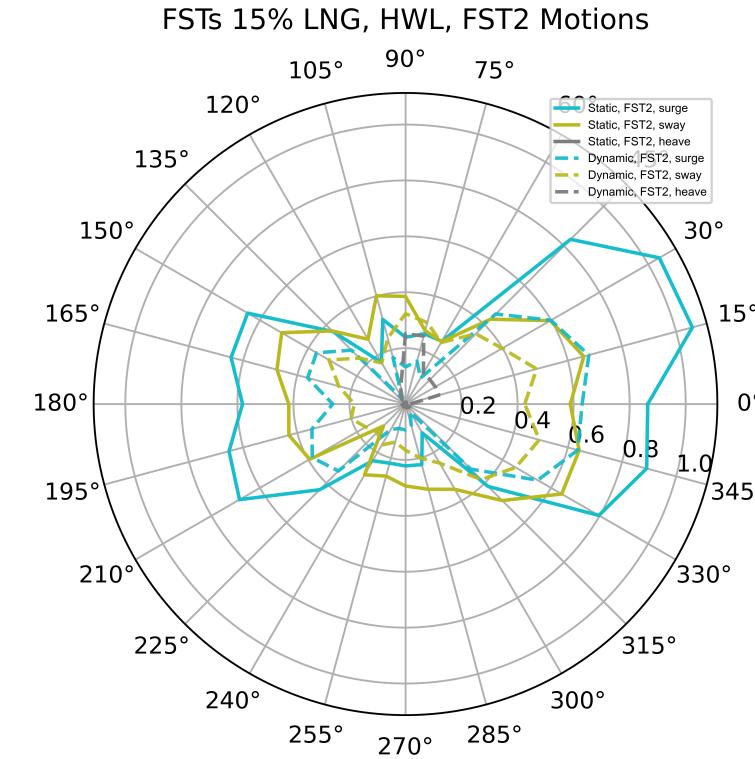
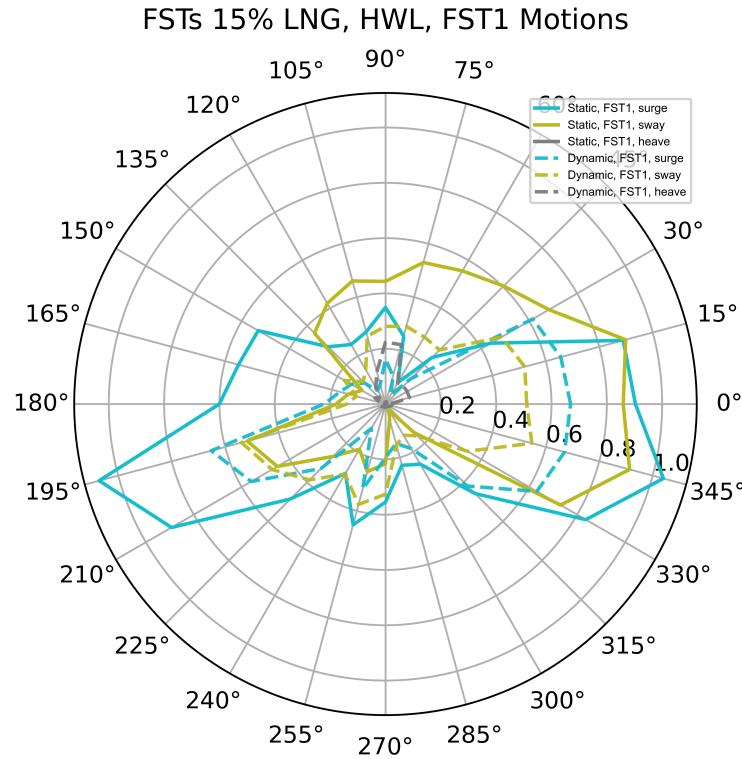
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FSTs 95% LNG, 100yr, HWL - FST Surge and Sway, Directional Response

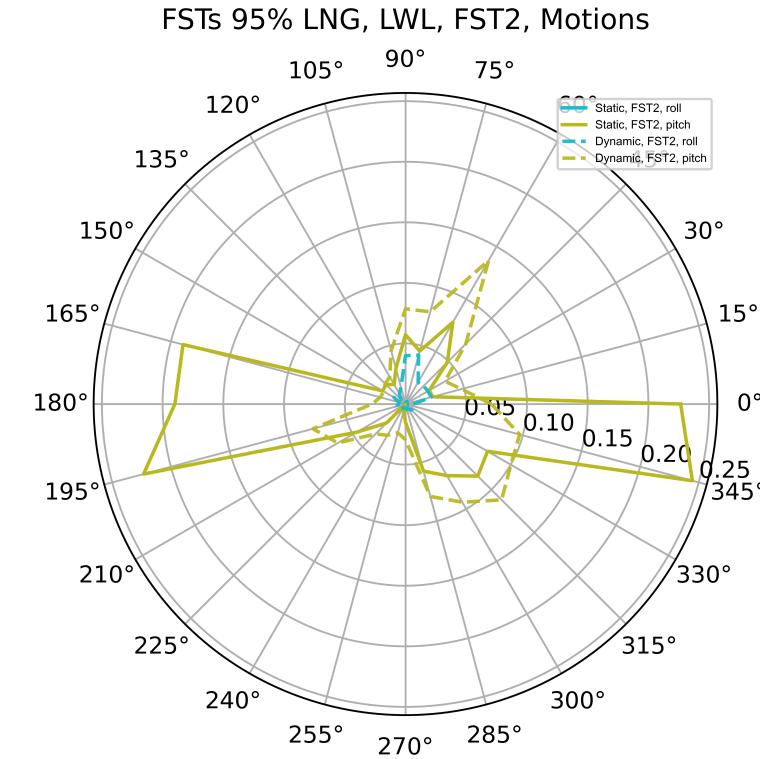
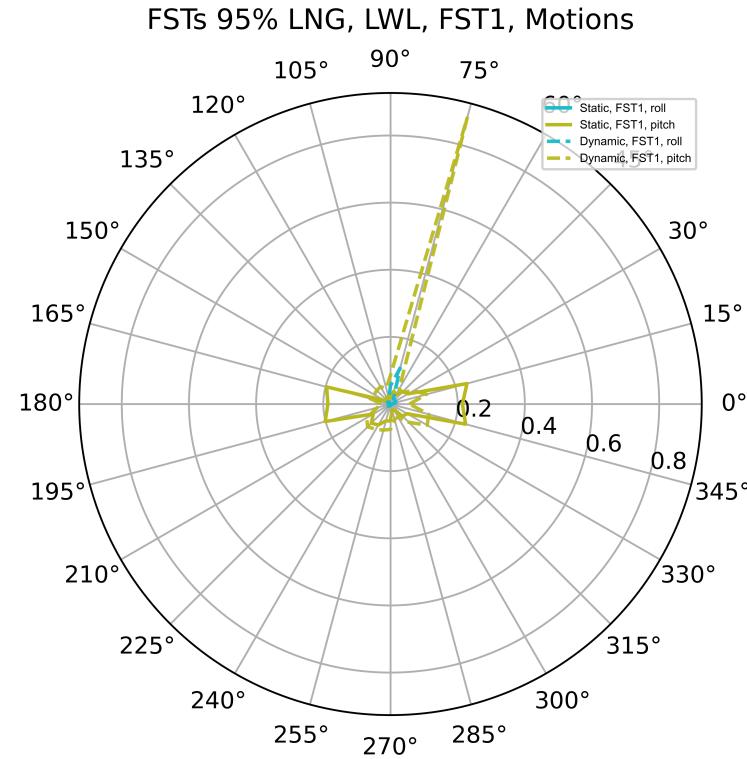
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FSTs 95% LNG, 100yr, LWL - FST Rotations, Directional Response

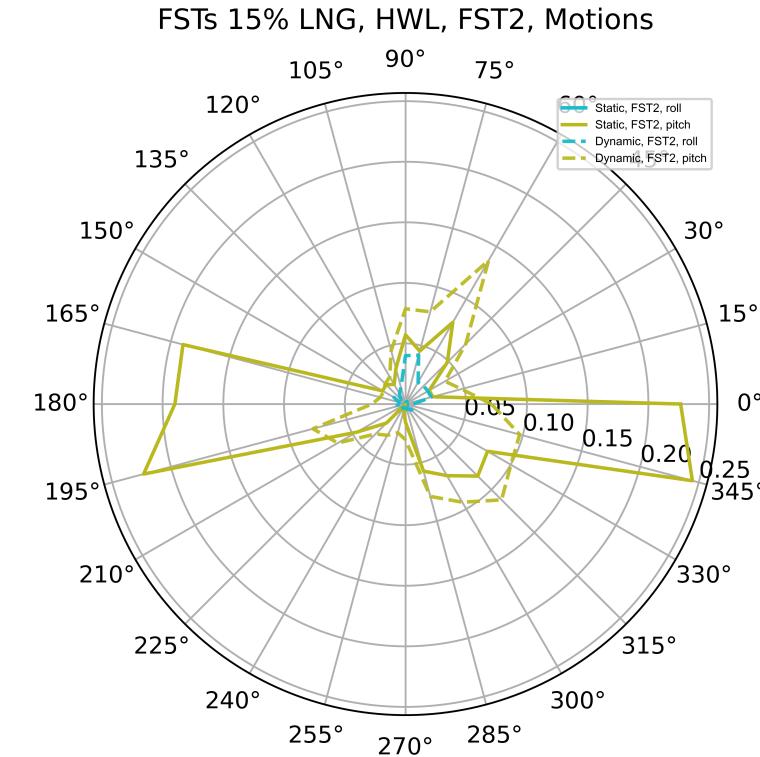
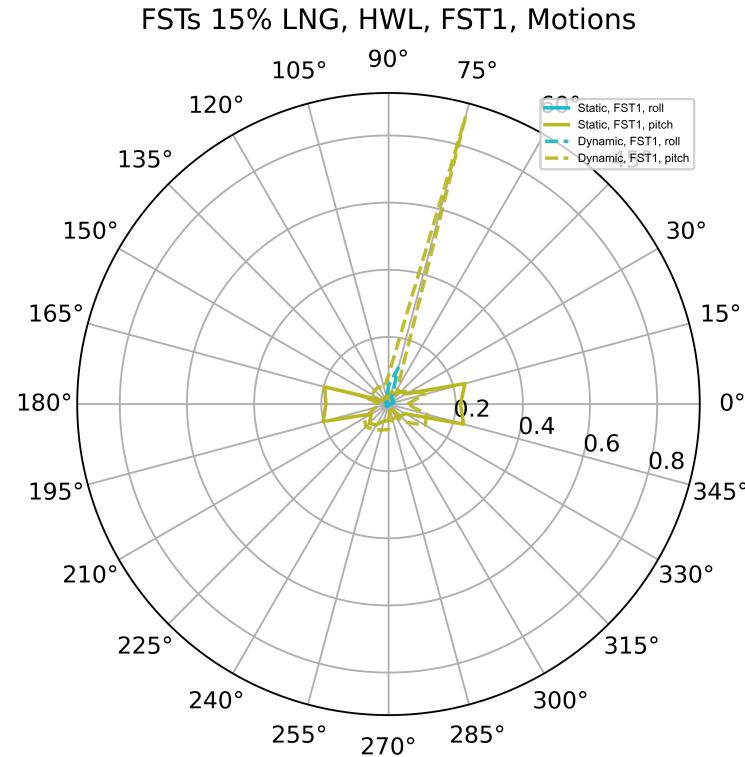
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FSTs 95% LNG, 100yr, HWL - FST Rotations, Directional Response

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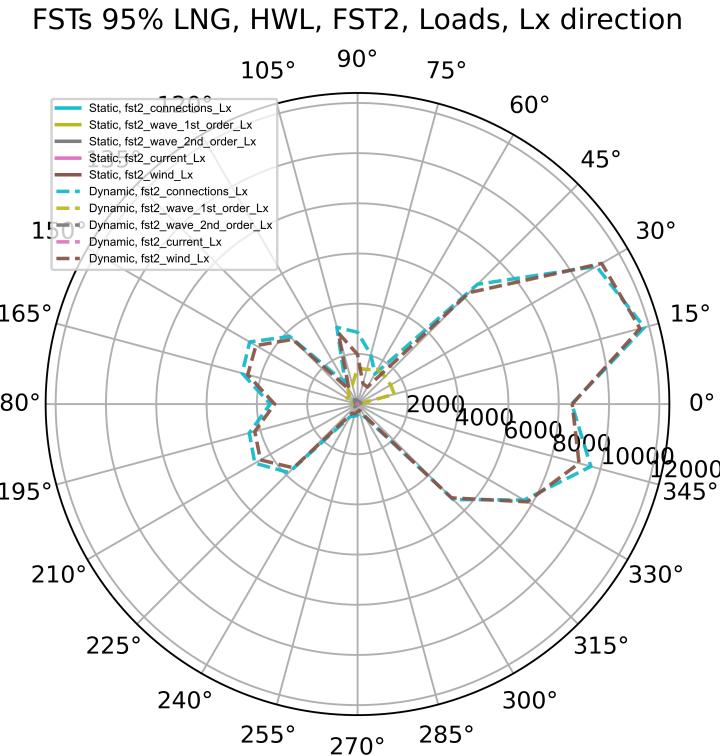
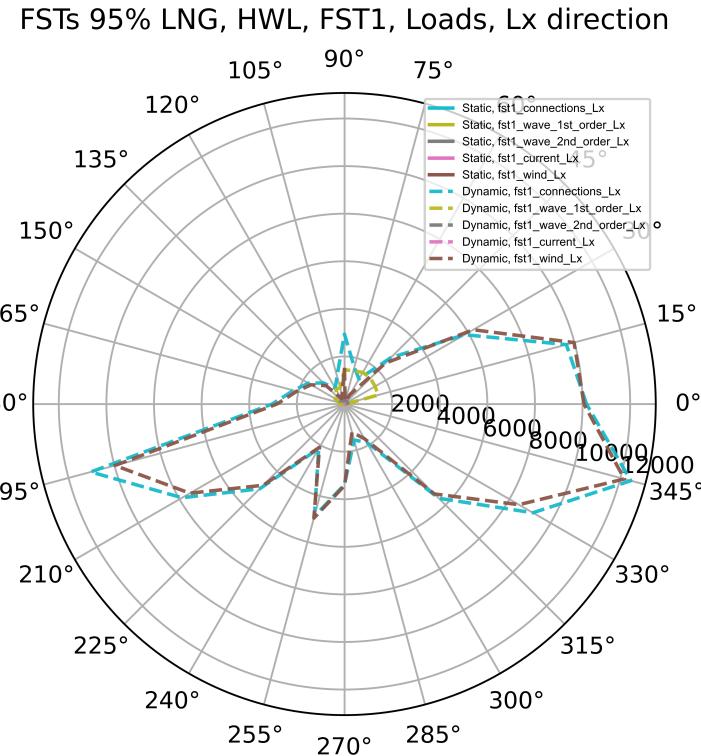


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FST Load Response

FSTs 95% LNG, 100yr, HWL - FST Loads, X Direction

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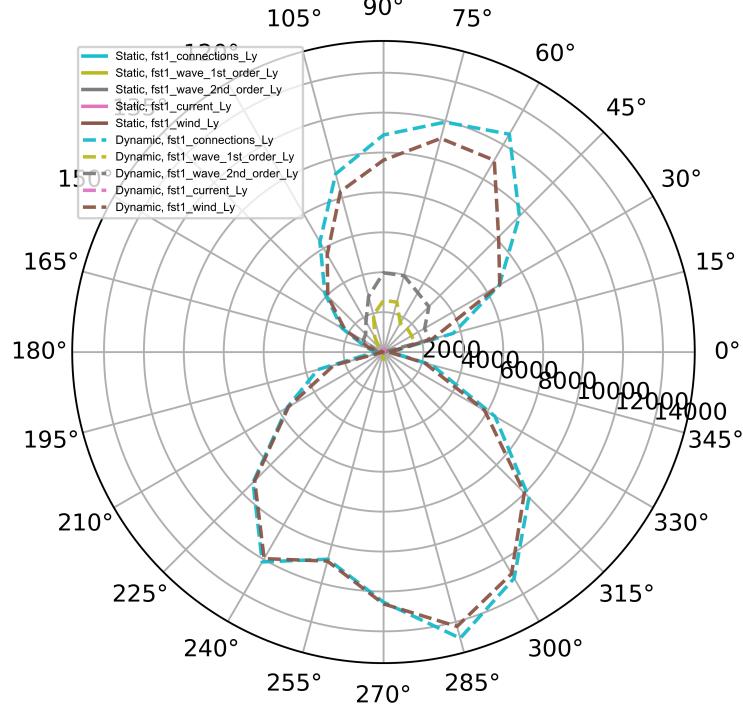


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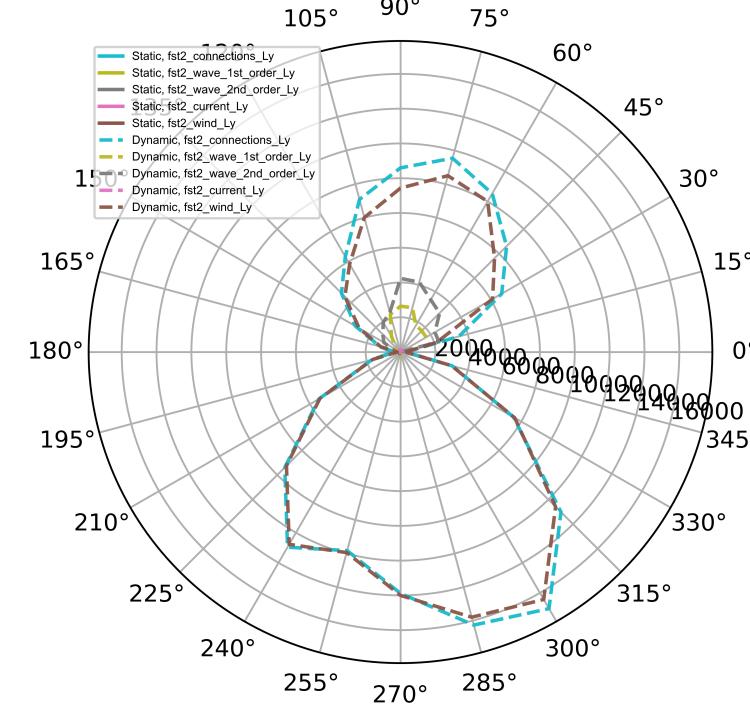
FSTs 95% LNG, 100yr, HWL - FST Loads, Y Direction

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FSTs 95% LNG, HWL, FST1, Loads, Ly direction



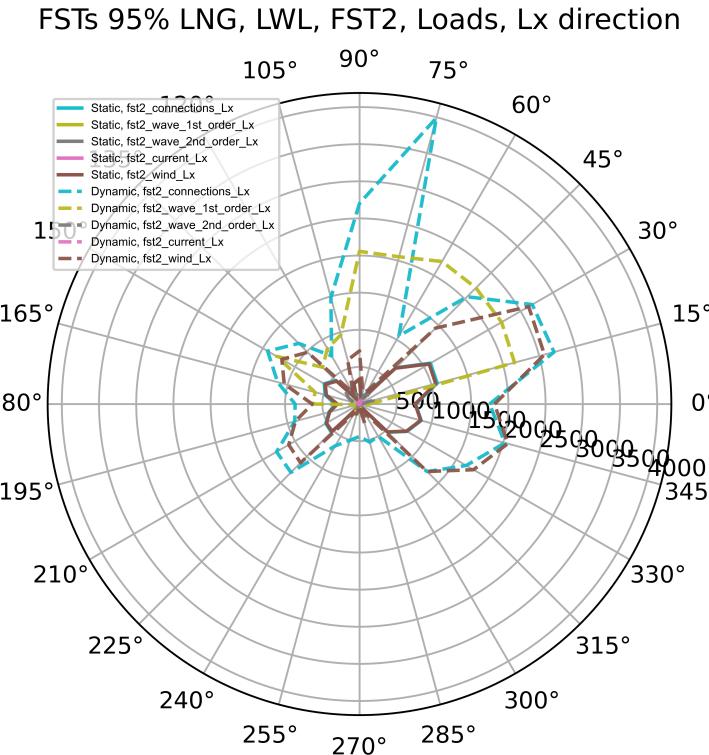
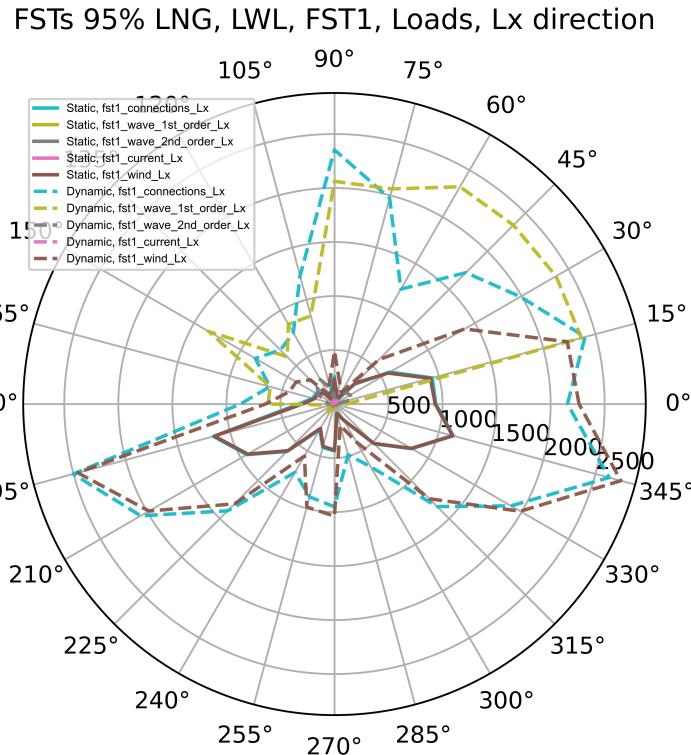
FSTs 95% LNG, HWL, FST2, Loads, Ly direction



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FSTs 15% LNG, 100yr, LWL - FST Loads, X Direction

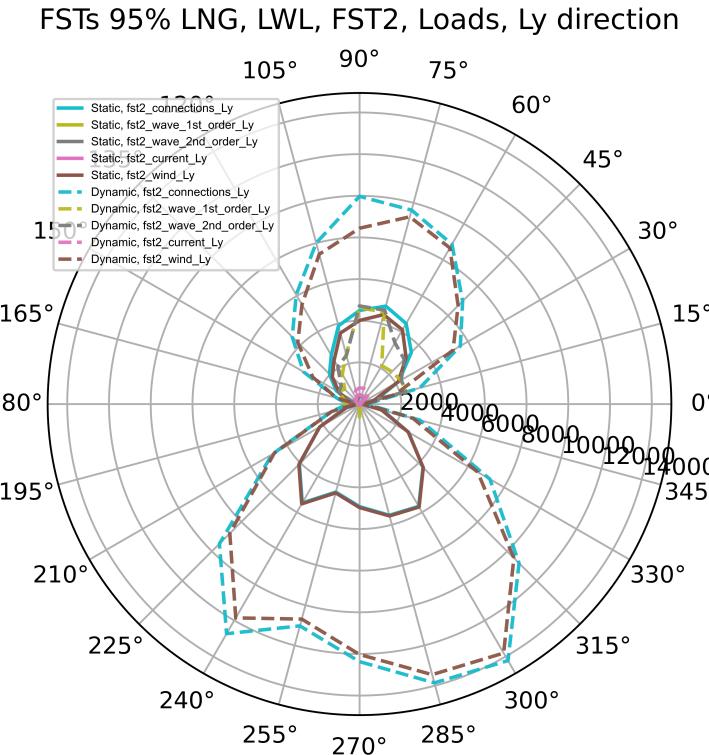
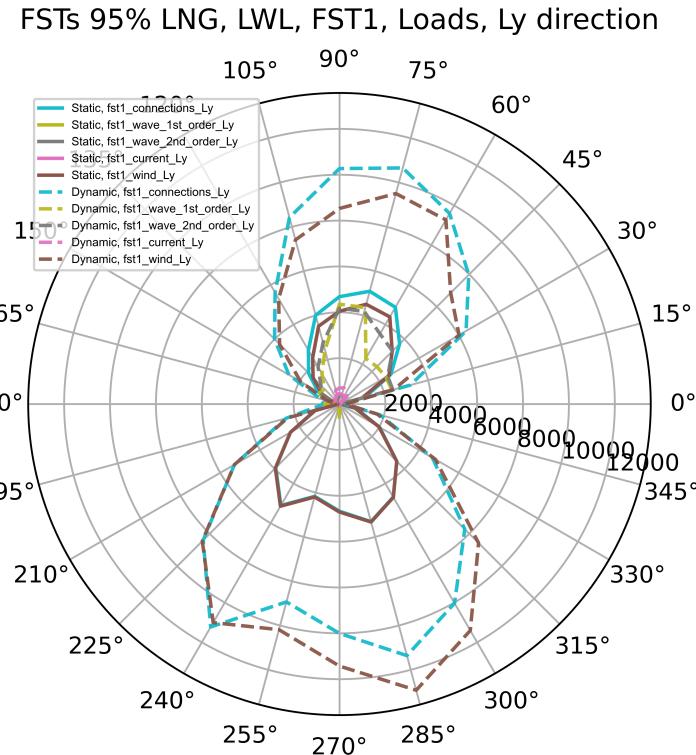
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FSTs 15% LNG, 100yr, LWL - FST Loads, Y Direction

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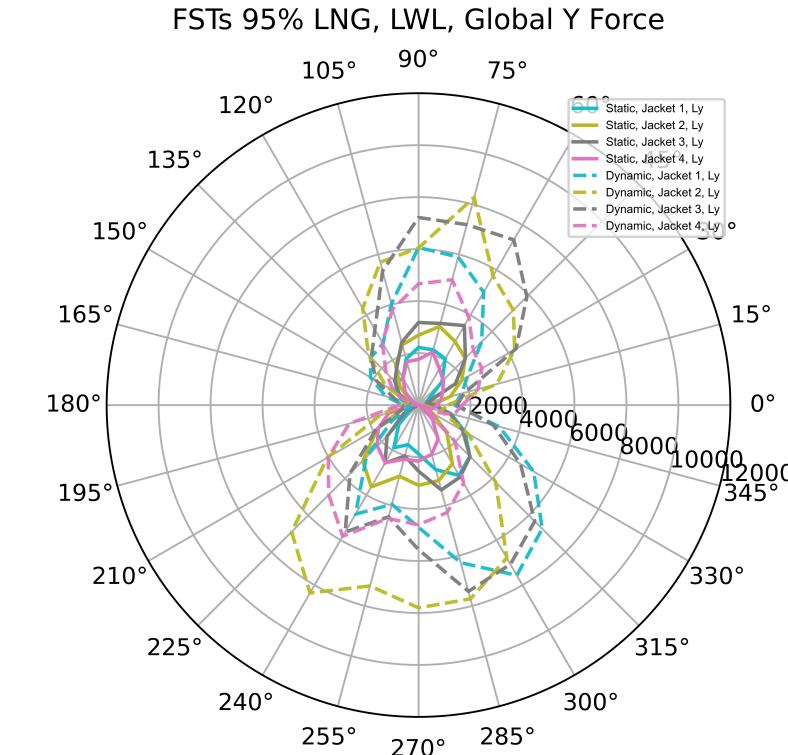
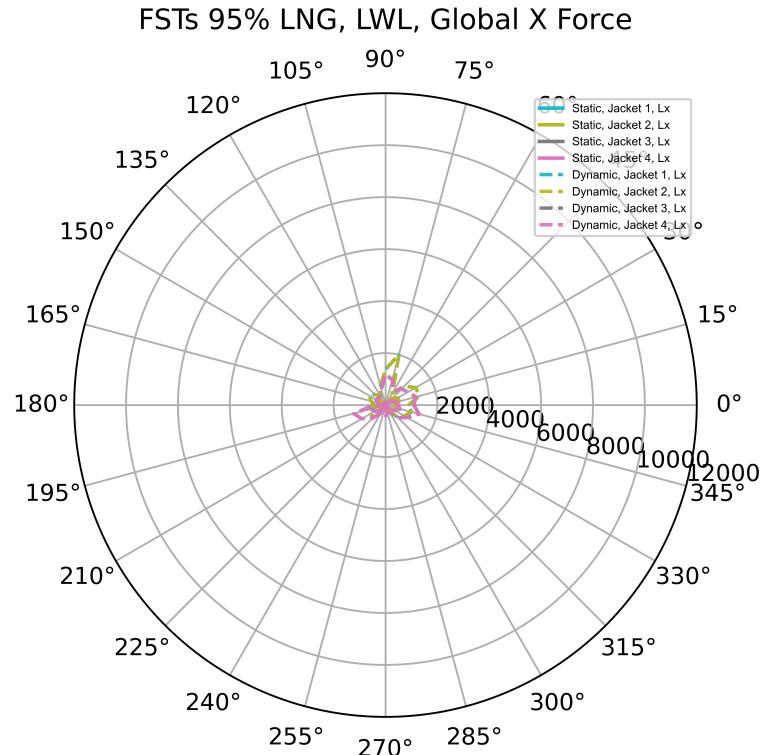


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Jacket Loads

FSTs 95% LNG, 100yr, LWL - Max Jacket Loads, Directional Response

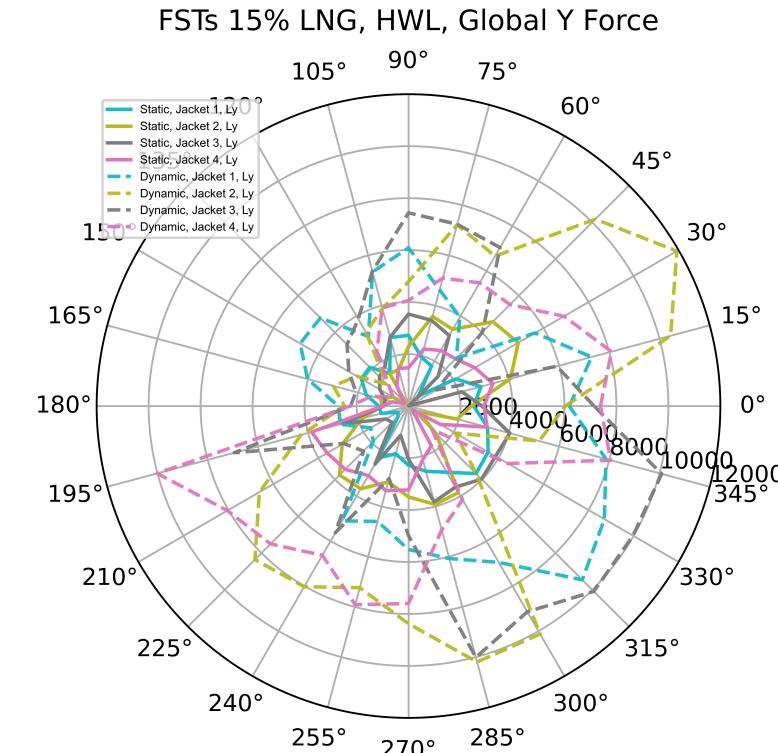
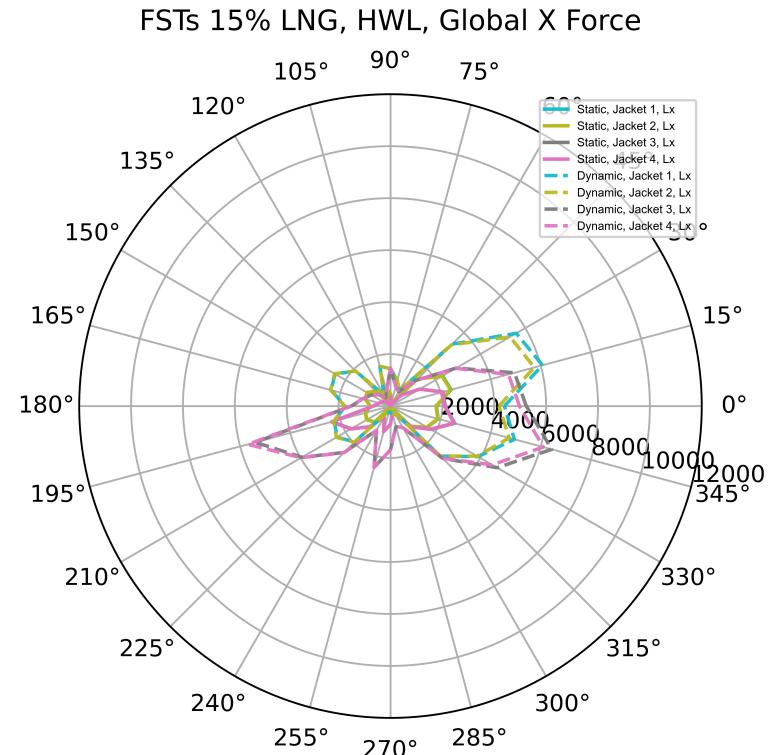
- LWL, Jacket Global forces in X and Y direction are shown
- Two (2) struts contribute to each jacket global force



- Y loads are significantly higher than X loads

FSTs 15% LNG, 100yr, HWL - Max Jacket Loads, Directional Response

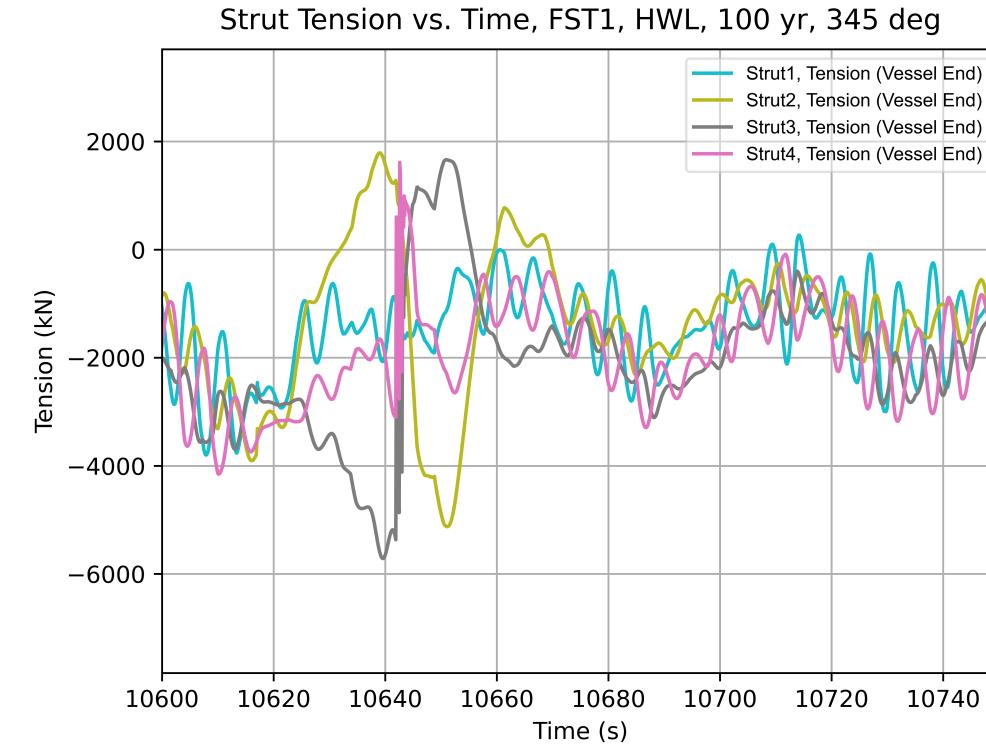
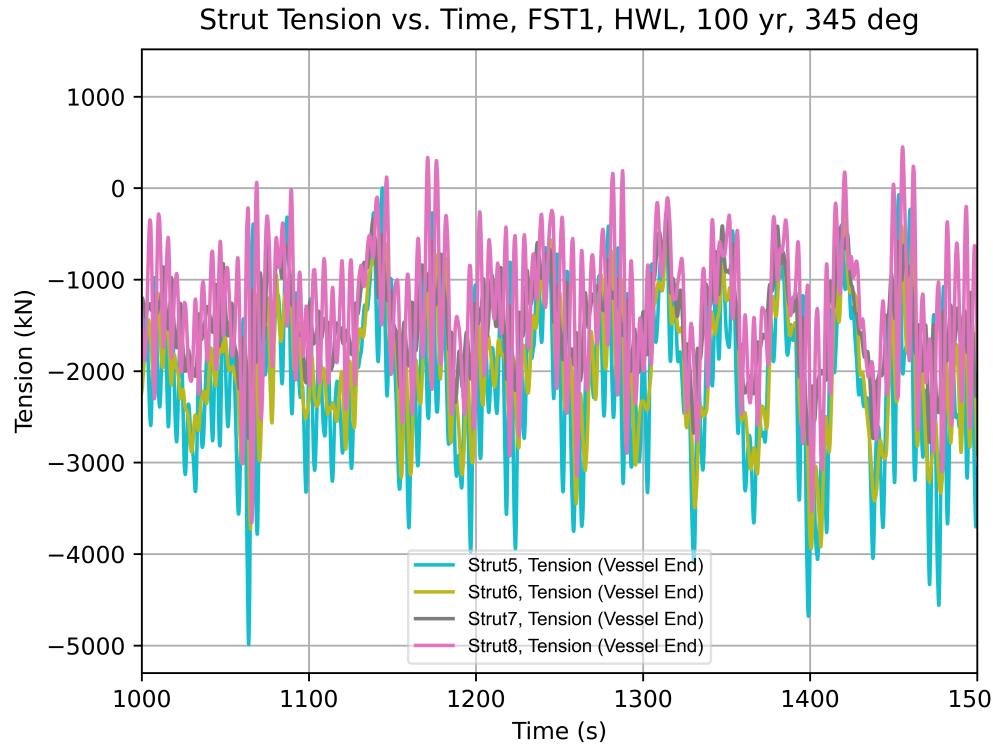
- HWL, Jacket Global forces in X and Y direction are shown
- Max loads are absolute maximum i.e. max (abs(max), abs(min))



- The HWL static & dynamic forces are significantly higher than those of LWL.
- The 15% LNG & LWL needs to be investigated further.

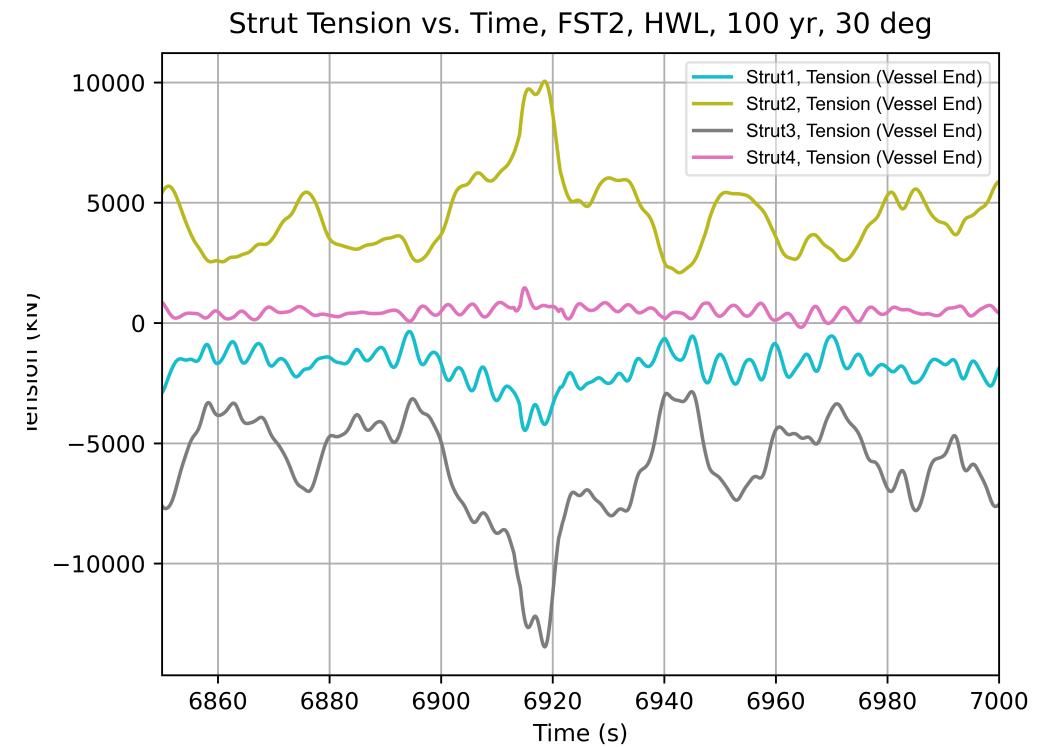
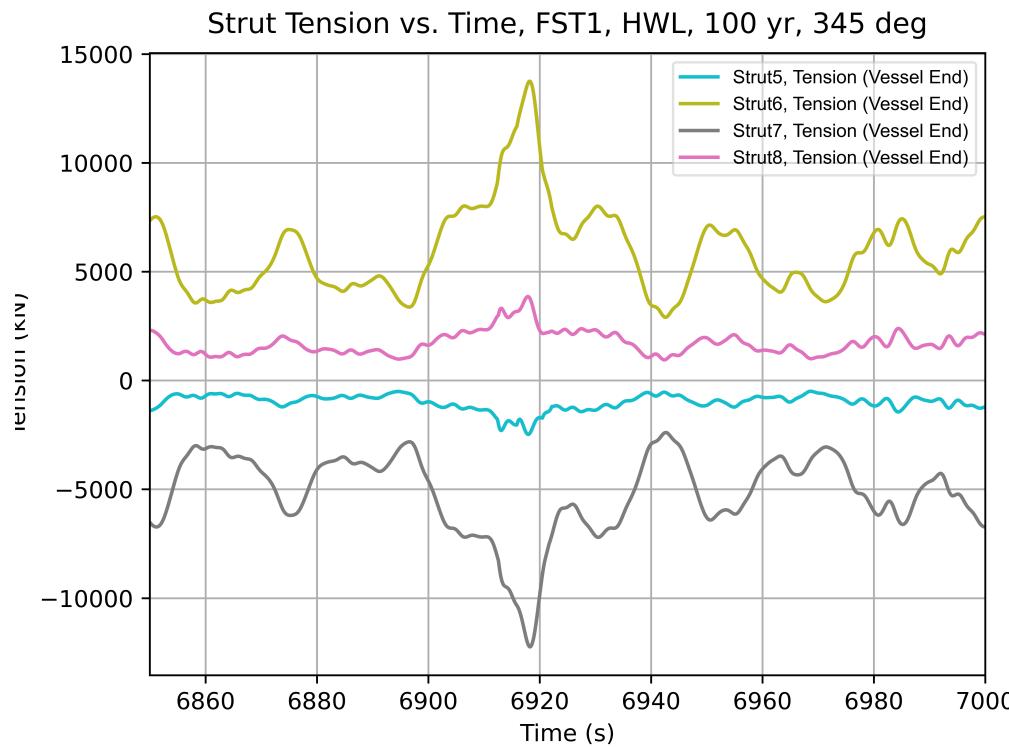
Strut Loads

FSTs 95% LNG, 100yr, LWL - Force Timetrace



- The struts are in sync
- Results in lower strut forces when compared to HWL results

FSTs 15% LNG, 100yr, HWL - Force Timetrace



- The 2 struts are locked FST in yaw position
 - Results in high forces
 - Low roll compared to LWL response
 - Comparable heave motions with LWL response
- This roll-locking result trend is similar to what was obtained in AQWA

FSTs, 100yr Discussion

- 100yr, HWL has roll-locking effect
 - potentially due to force coefficients used
- Perform sensitivity analysis on force coefficients with yaw-coeffs = 0
- Determine whether roll-locking effect is realistic due to prevailing external non-dynamic forces (e.g. wind, current, wave etc.)

Conclusions

Way Forward

- FST roll-locking effect
 - Theoretically, this effect may be possible.
 - Recommend permanent moring system designer, WSP to verify that this phenomenon does not occur from their design.
 - FST strut interface foundation is currently designed for all loads presented in this document.

Way Forward

- 100 yr FSTs only
 - Perform sensitivity
- 5 yr FSTs with LNGC
 - Will get this running after few more insights in 100 yr analysis