WLNG FST Engineering Completion

WLNG FST Extreme Weather Analysis

Inputs and FST

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2025-02-01

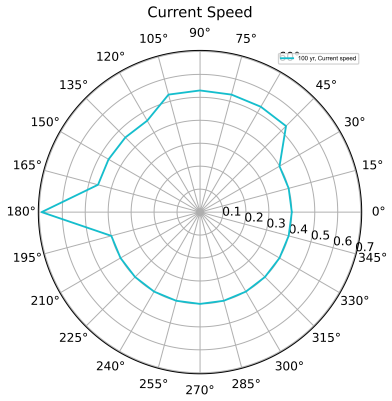
Introduction

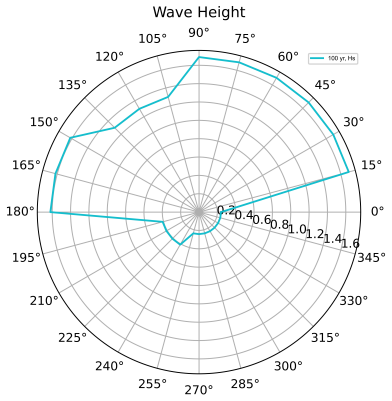
- FST analysis for WLNG

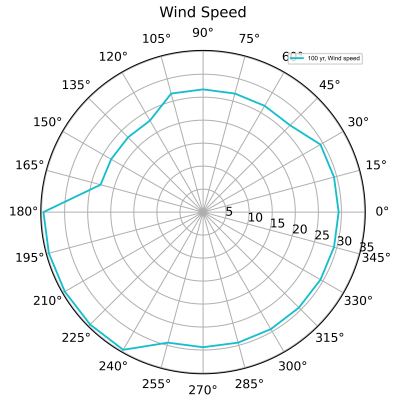
Design Data

Analysis Methodology

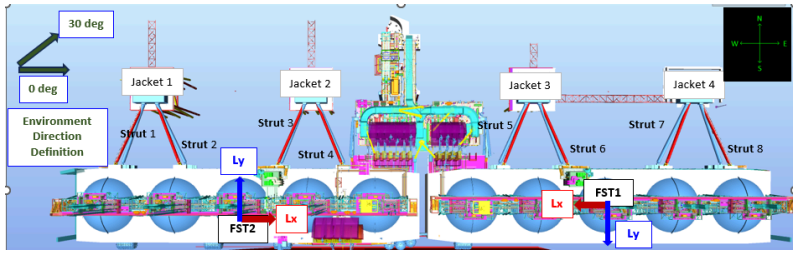
Design Data - Environment





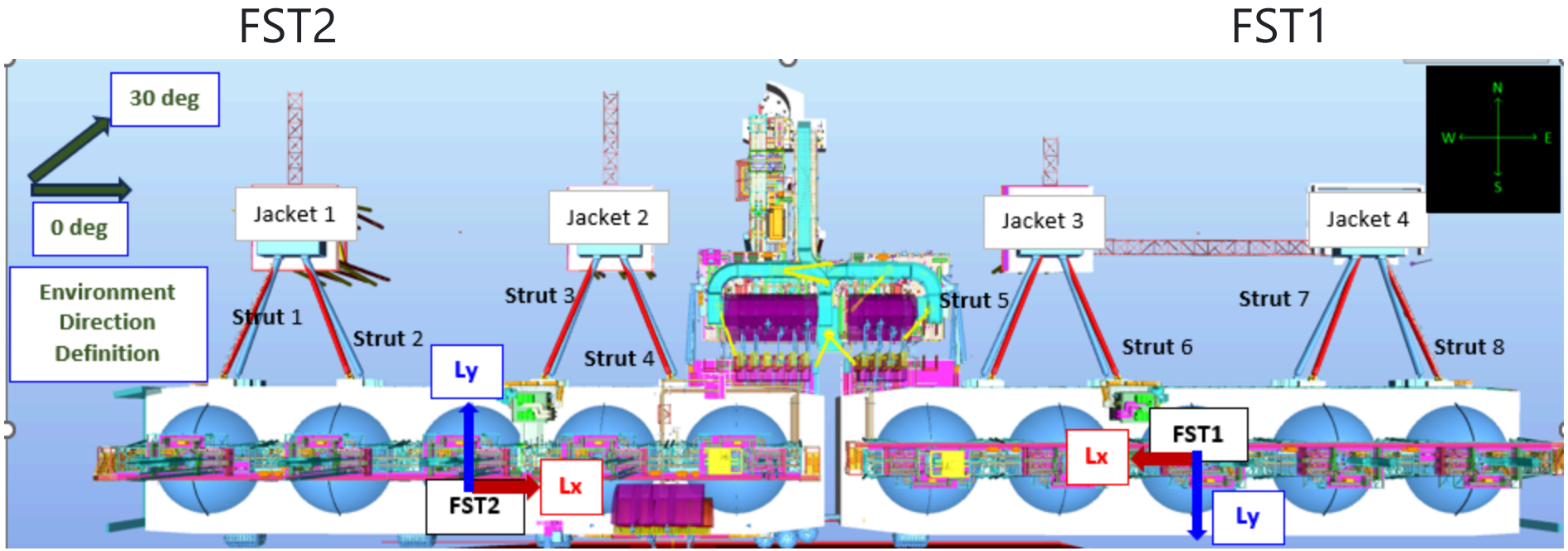


FST2 FST1



- Radial plots axis is based on environment direction

FSTs Only, General Arrangement



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

Methodology

- TBA

Methodology - Analysis

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Methodology - Result Interpretation

- Timetrace plots are actual values (not statistical)
  - Strut positive tension is tension and negative tension 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 value change with direction.
    - The increase/decrease help determine the max force directions.
  - Static values: absolute values
  - Dynamic values: absolute maximum i.e. max (abs(max), abs(min))

100 year Analysis Results

FST Motion Response

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

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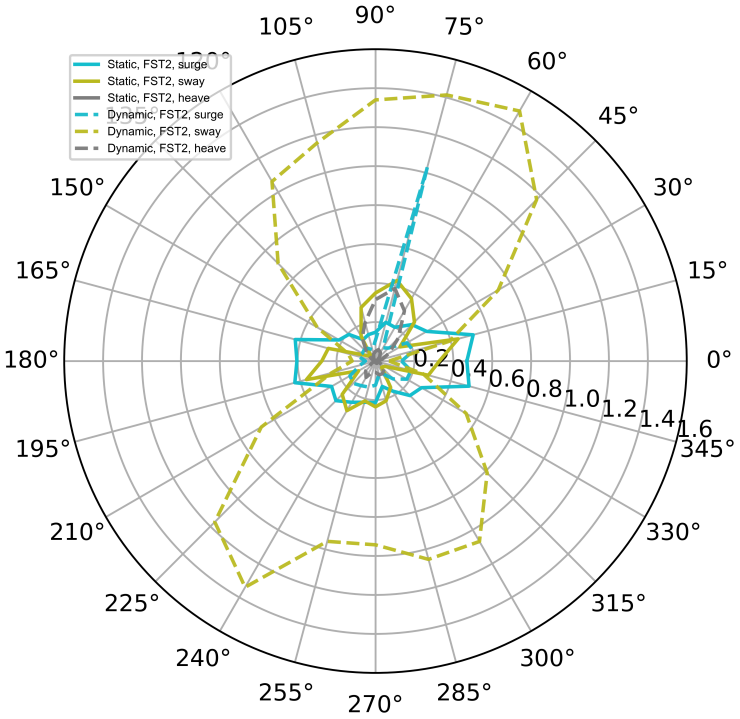
FST2



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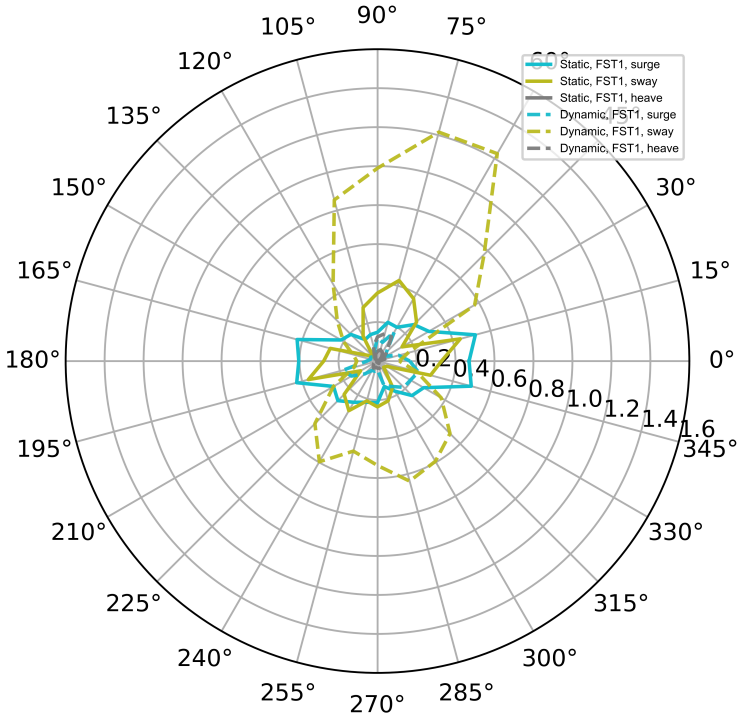

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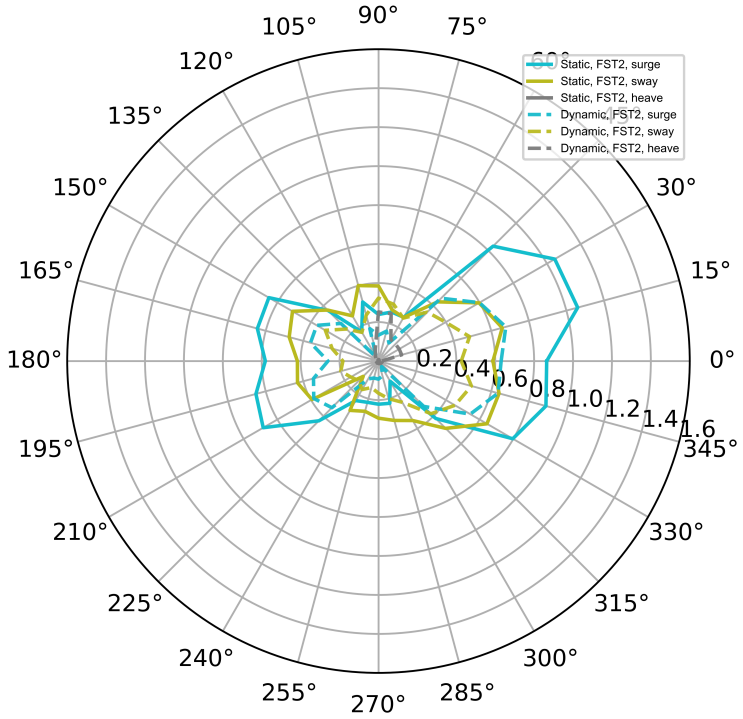
FSTs 15% LNG, 100yr, HWL - FST Surge and Sway

- TBA

FST2



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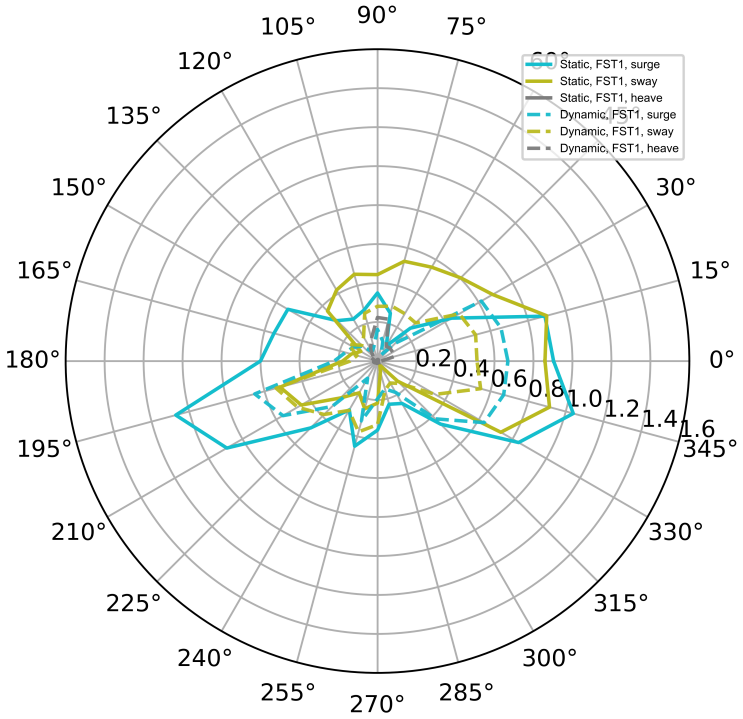

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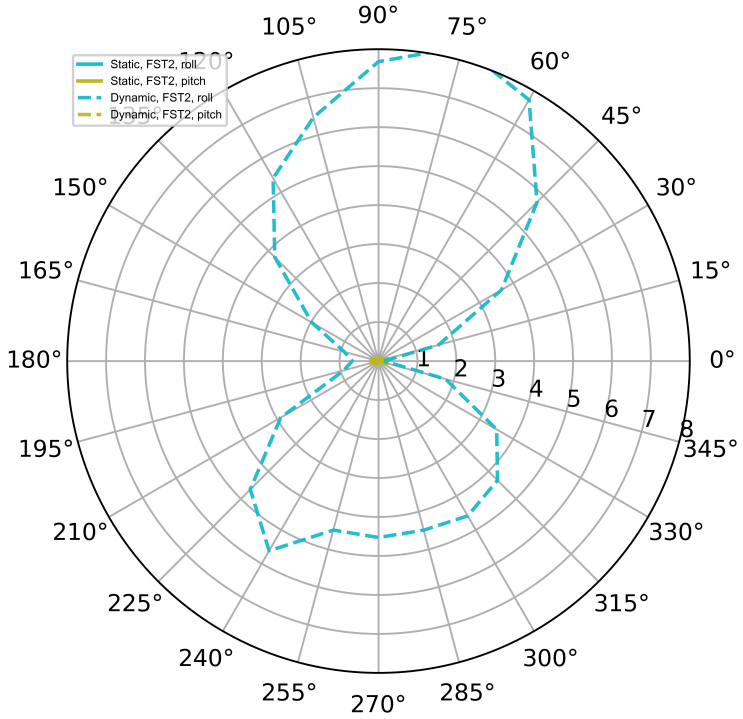
FSTs 95% LNG, 100yr, LWL - FST Rotations

- TBA

FST2



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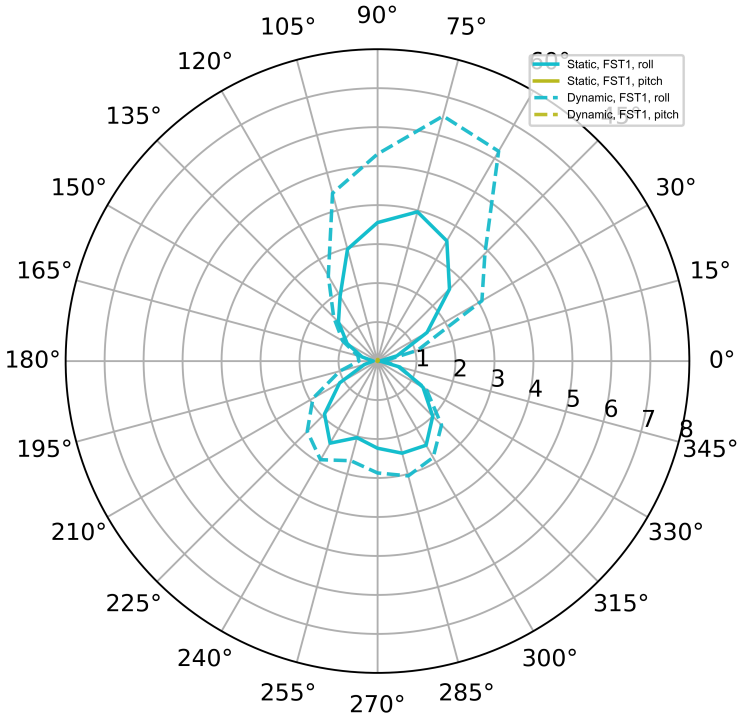

- TBA

FSTs 15% LNG, 100yr, HWL - FST Rotations

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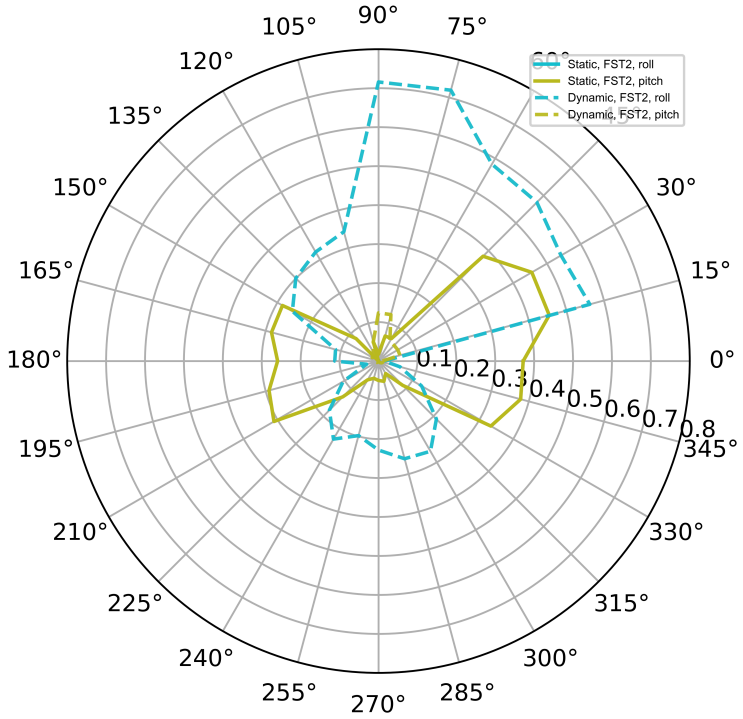
FST2



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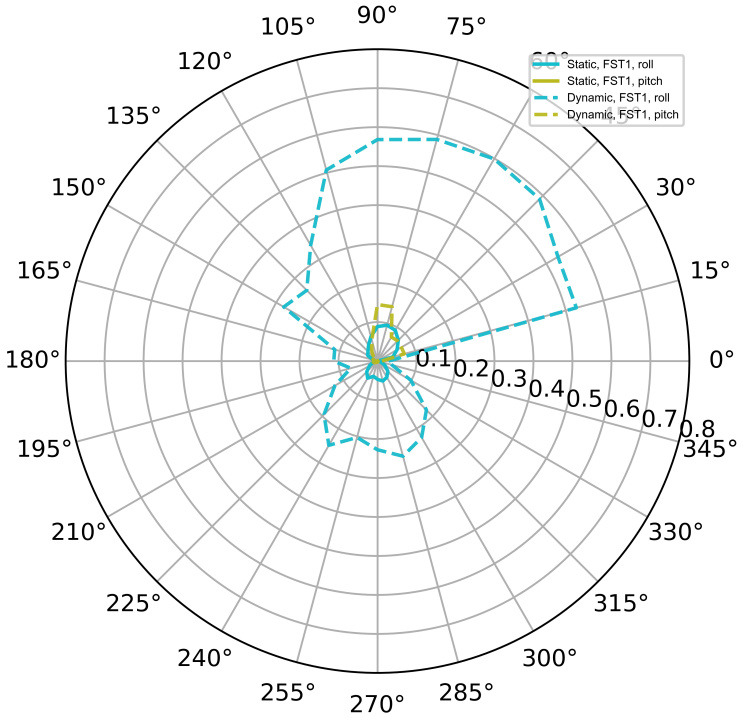

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FST Rotations, 100 yr, LWL vs. HWL

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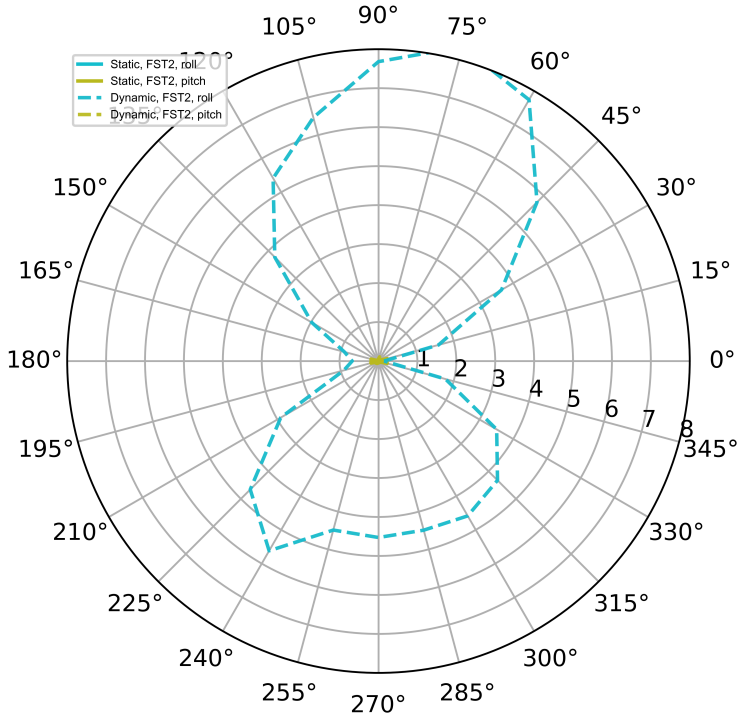
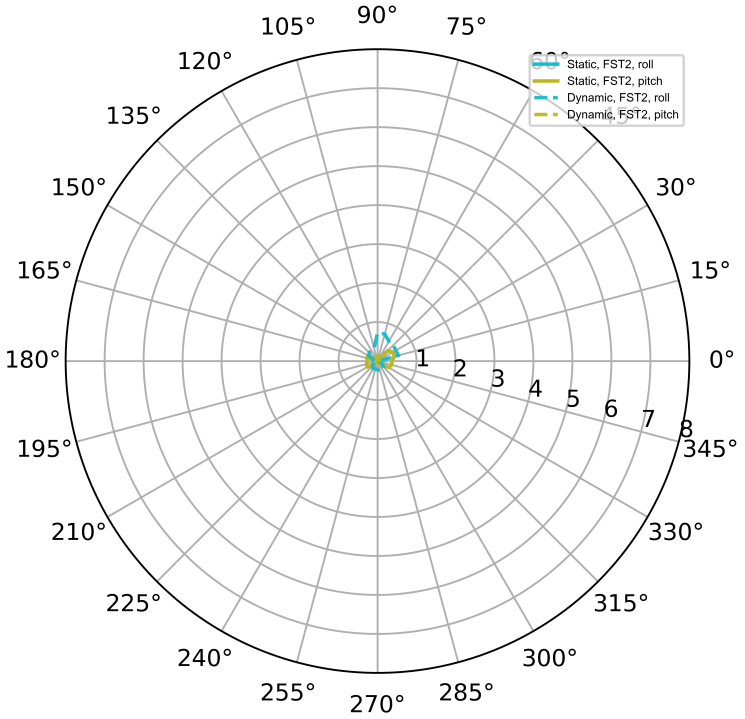
LWL



HWL



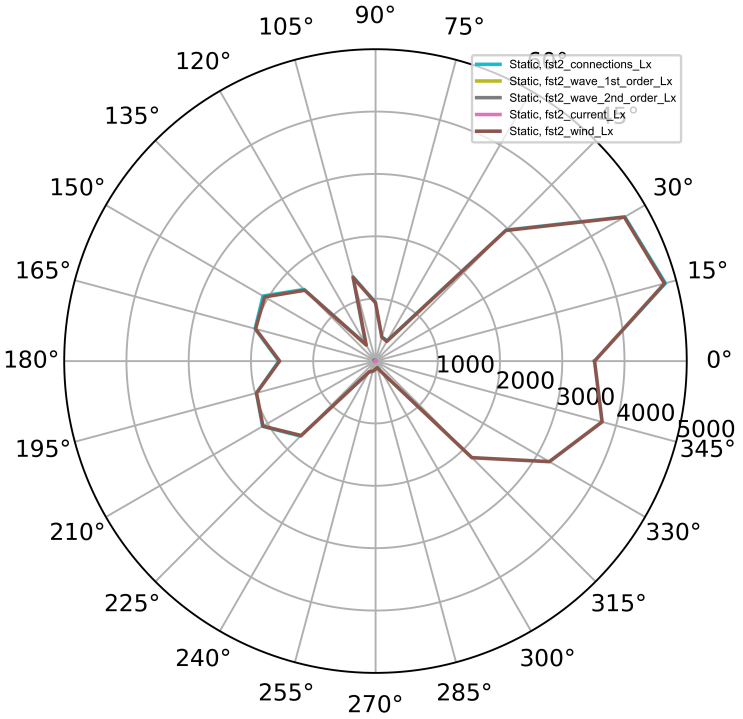
- 15% LNG, HWL has low roll rotations compared to 95% LNG, LWL

FST Load Response, Static

FSTs 95% LNG, 100yr, HWL, FST Forces, X Direction

- TBA

FST2



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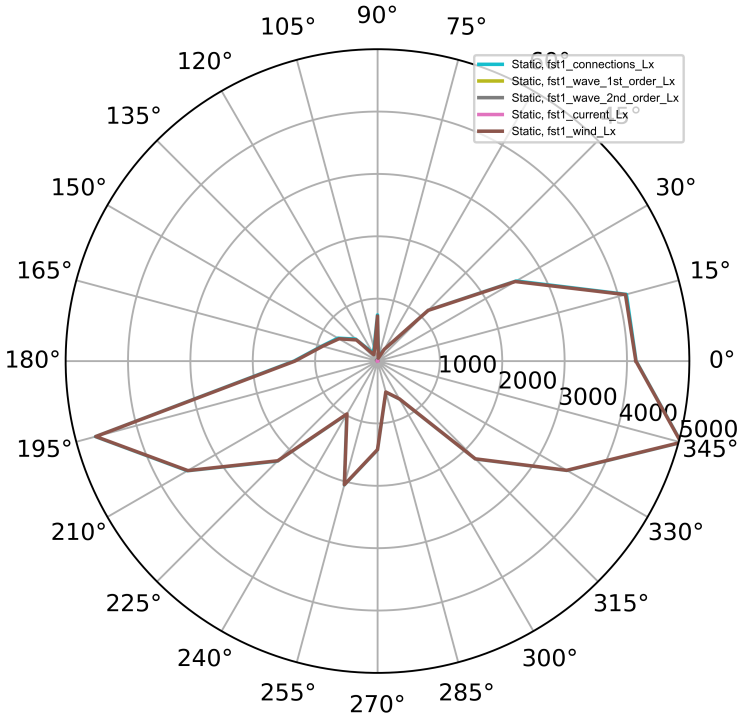


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- Wind loads dominate the FST forces
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FSTs 95% LNG, 100yr, HWL, FST Forces, Y Direction

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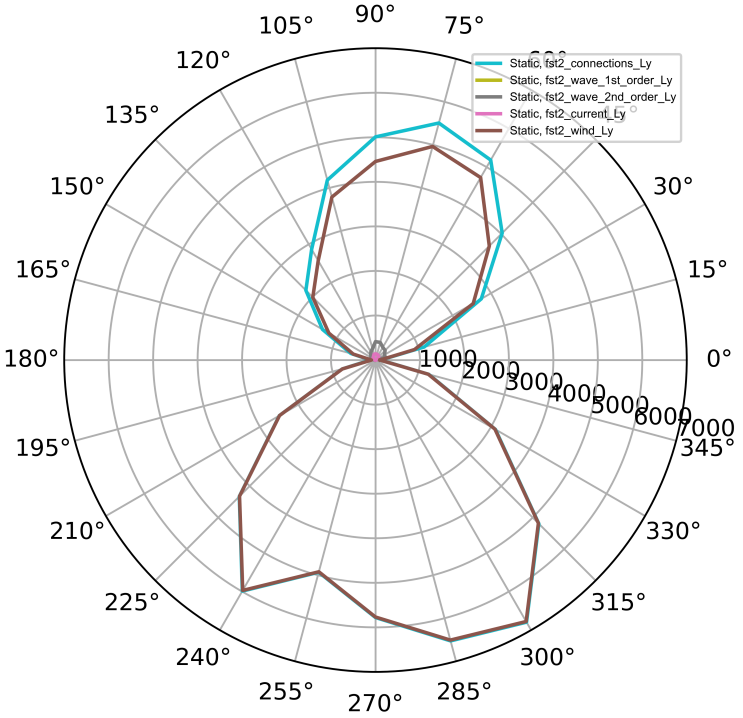
FST2



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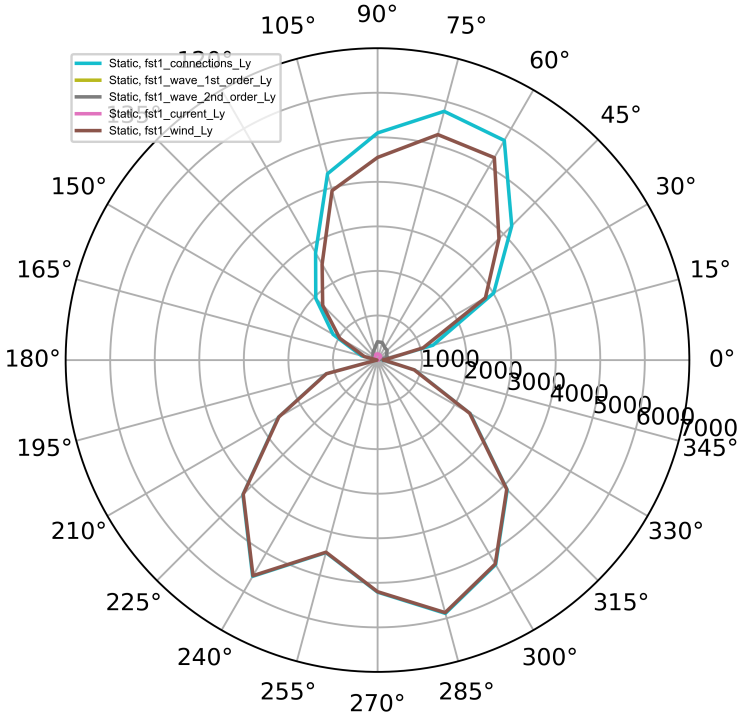

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FSTs 15% LNG, 100yr, LWL, FST Forces, X Direction

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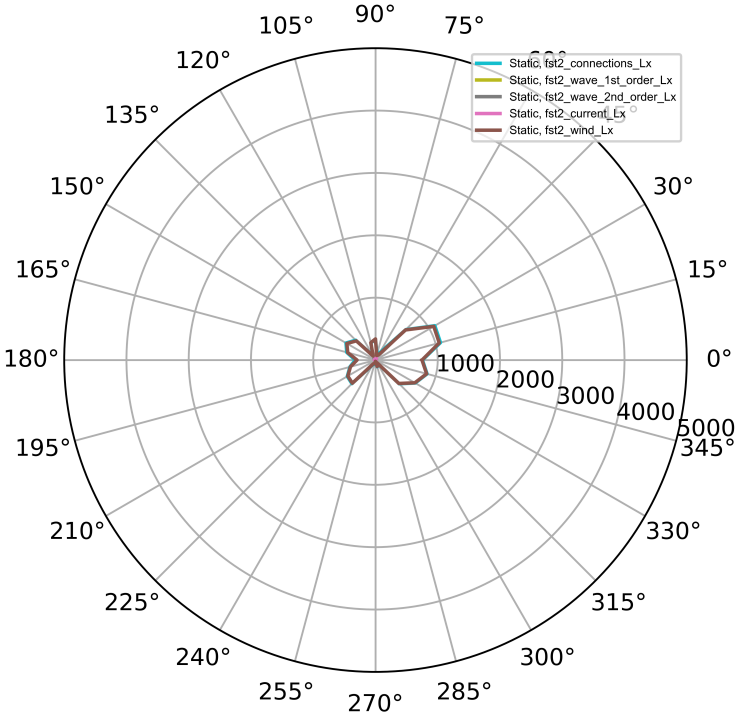
FST2



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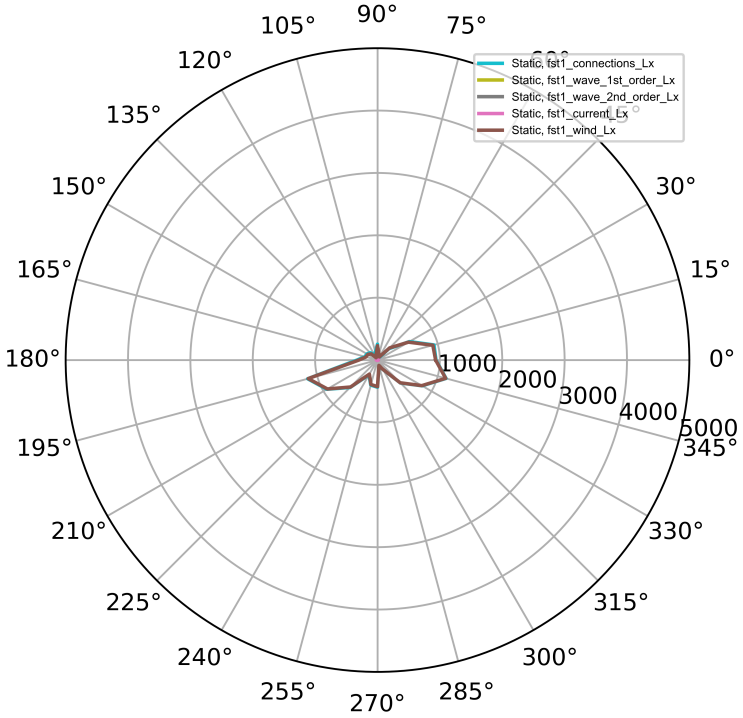

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FSTs 15% LNG, 100yr, LWL, FST Forces, Y Direction

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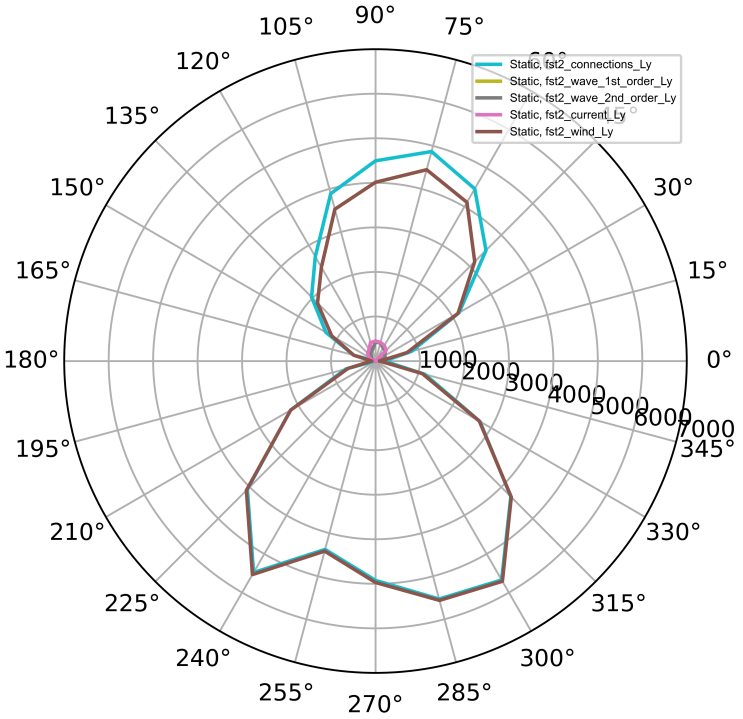
FST2



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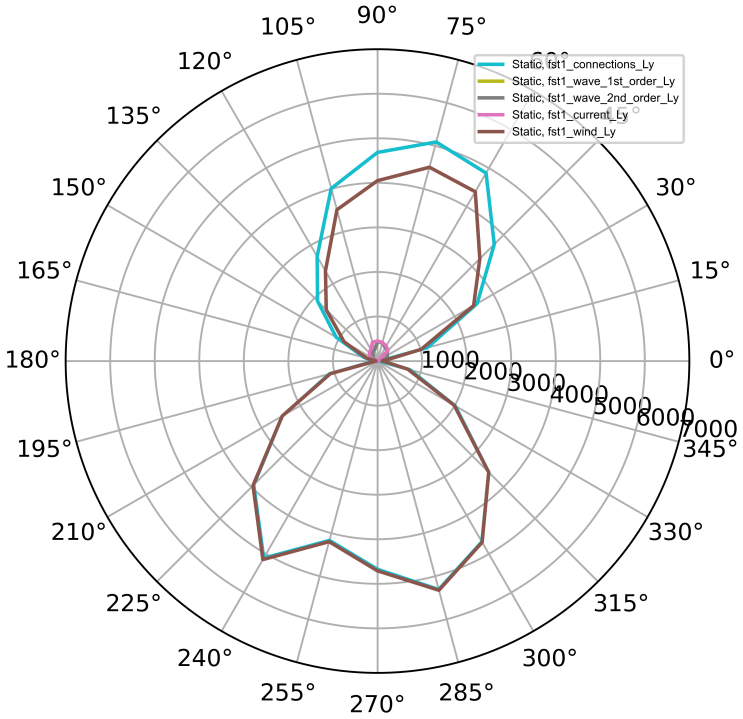

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FST Load Response, Dynamic

FSTs 95% LNG, 100yr, HWL, FST Forces, X Direction

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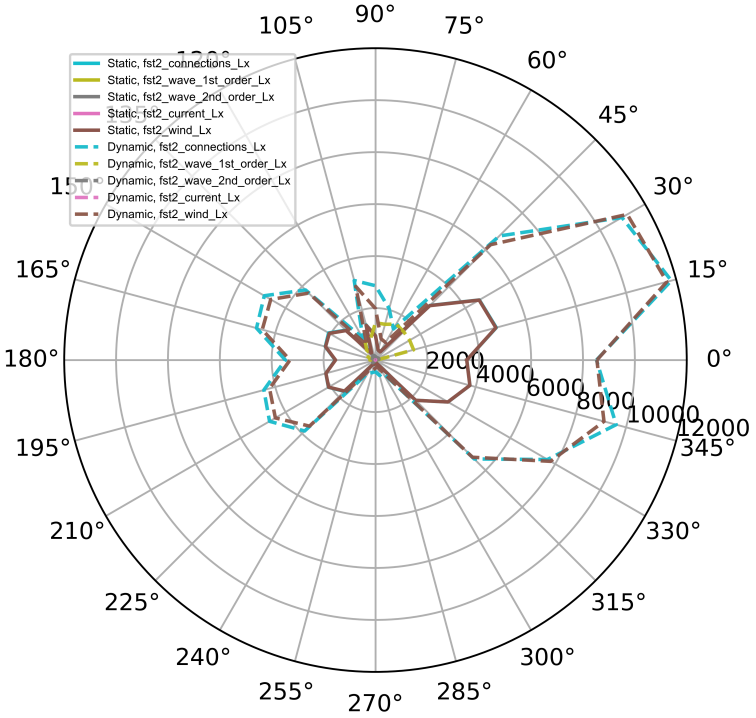
FST2



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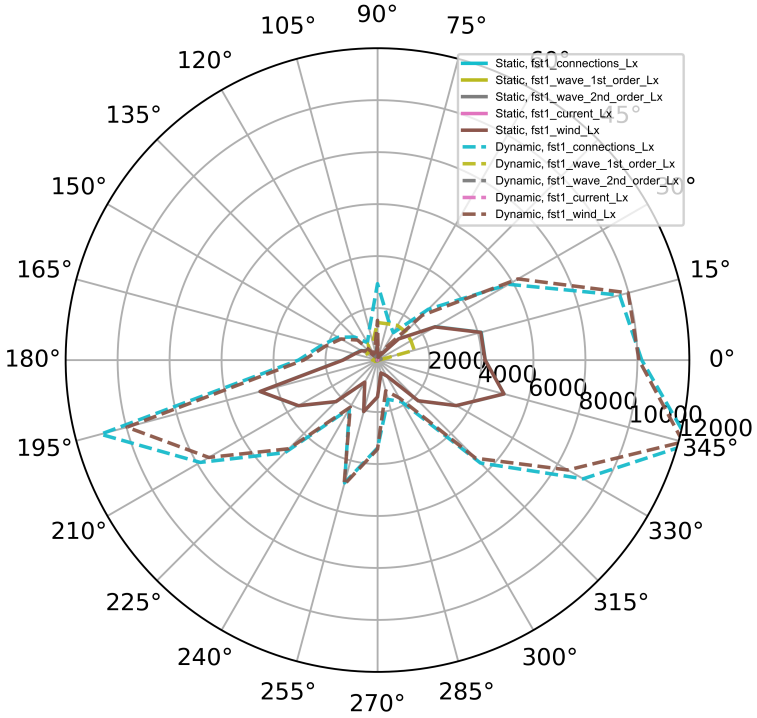

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FSTs 95% LNG, 100yr, HWL, FST Forces, Y Direction

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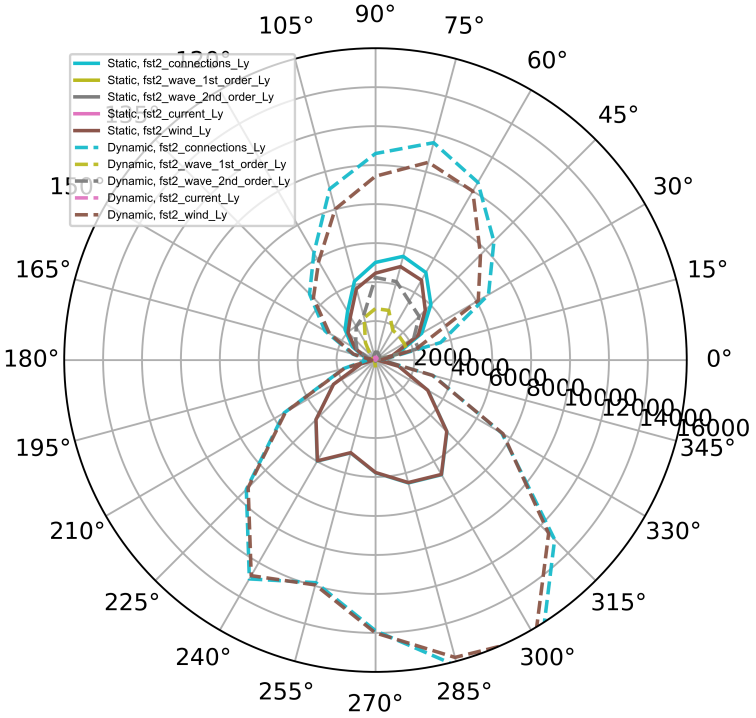
FST2



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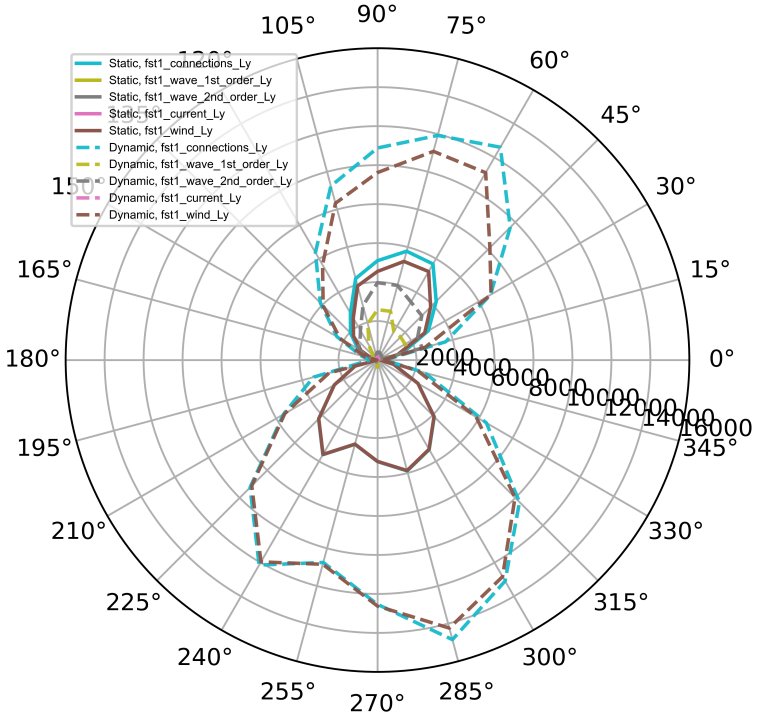

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FSTs 15% LNG, 100yr, LWL, FST Forces, X Direction

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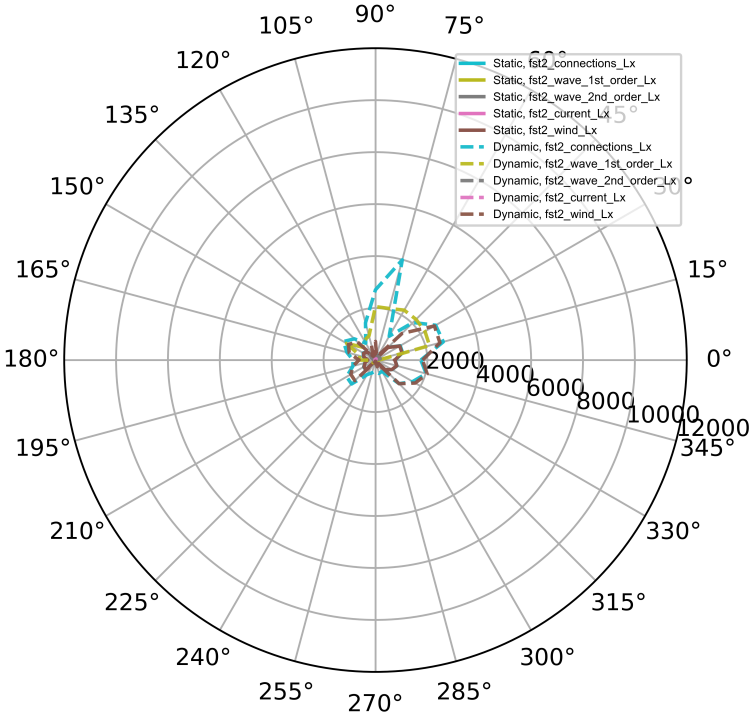
FST2



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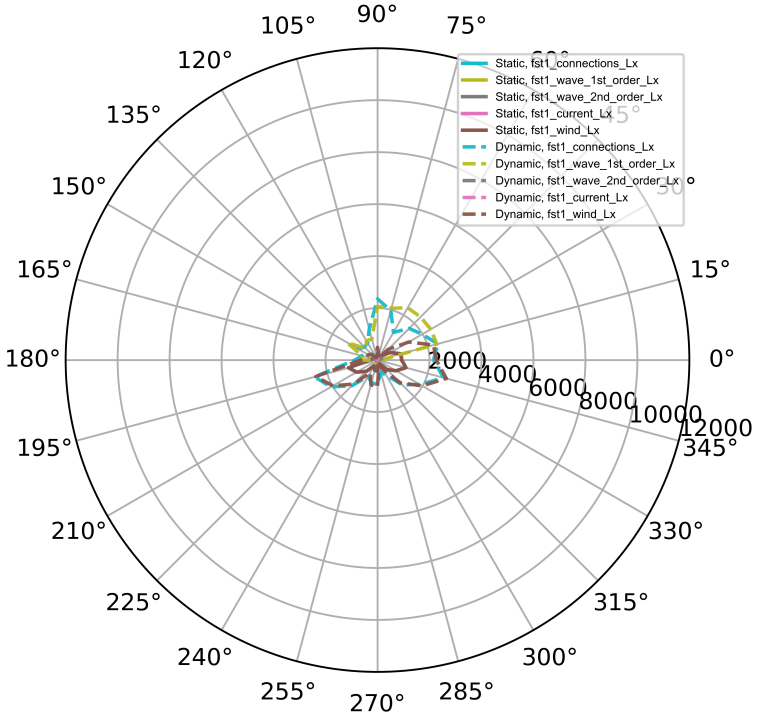

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FSTs 15% LNG, 100yr, LWL, FST Forces, Y Direction

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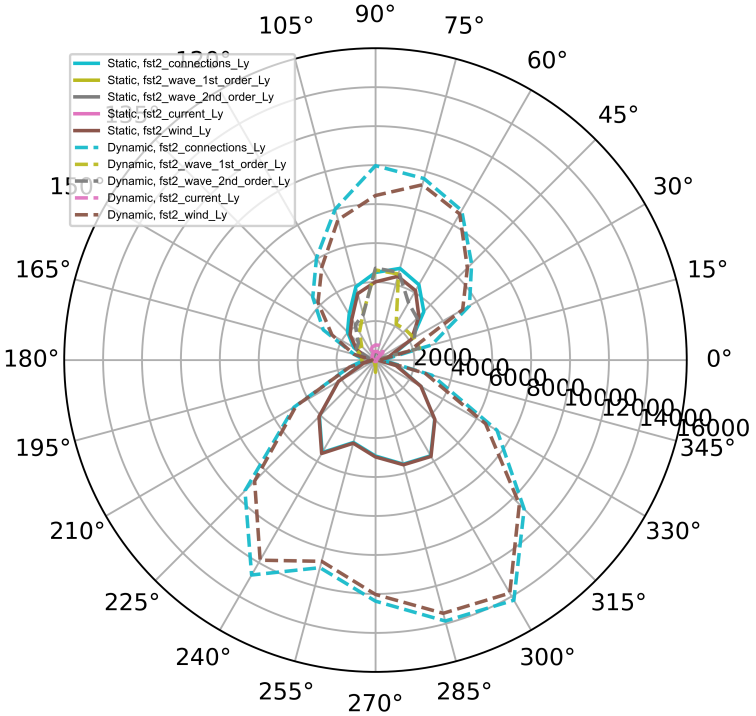

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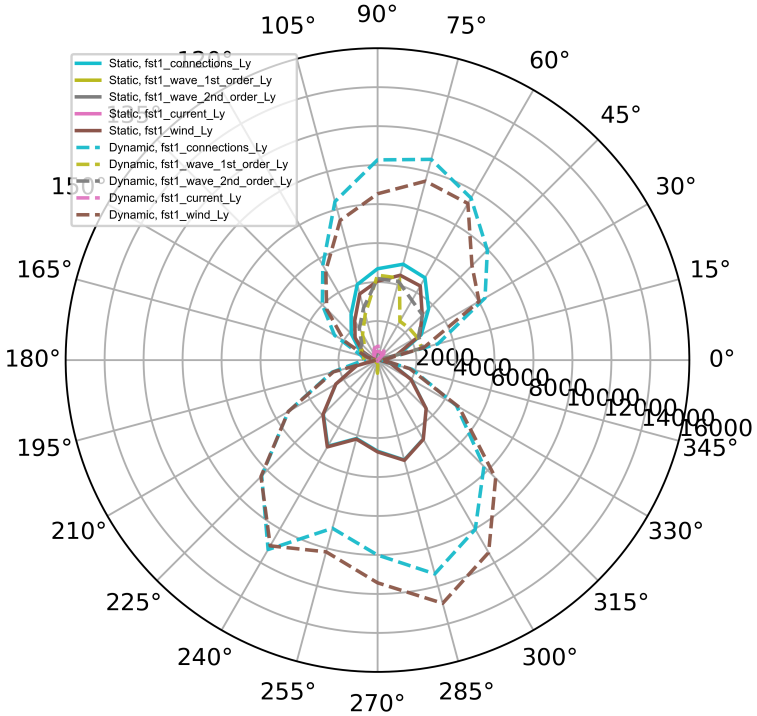


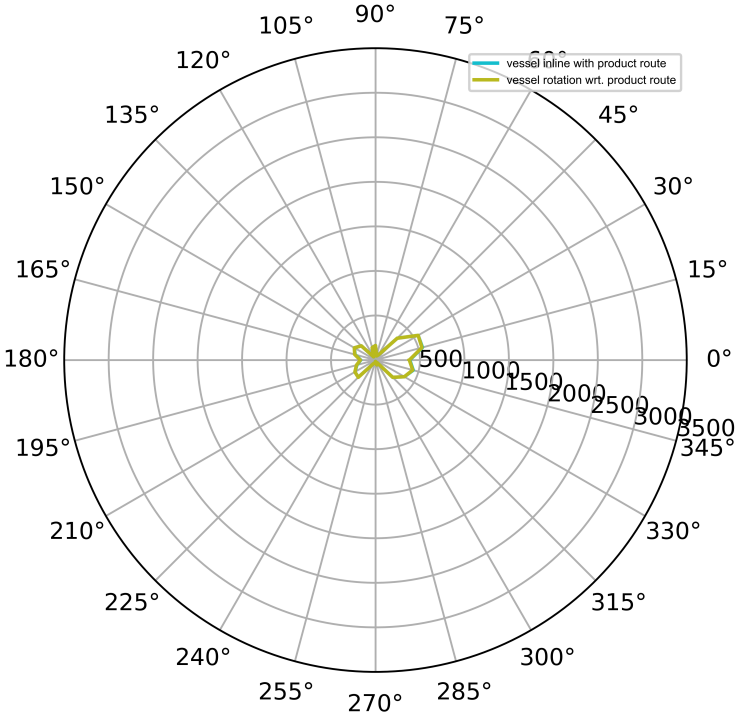
- TBA

Jacket Loads, Static

Max Jacket Loads, FSTs 95% LNG, 100yr, LWL, Fx

- Two (2) struts contribute to each jacket global force

FST2



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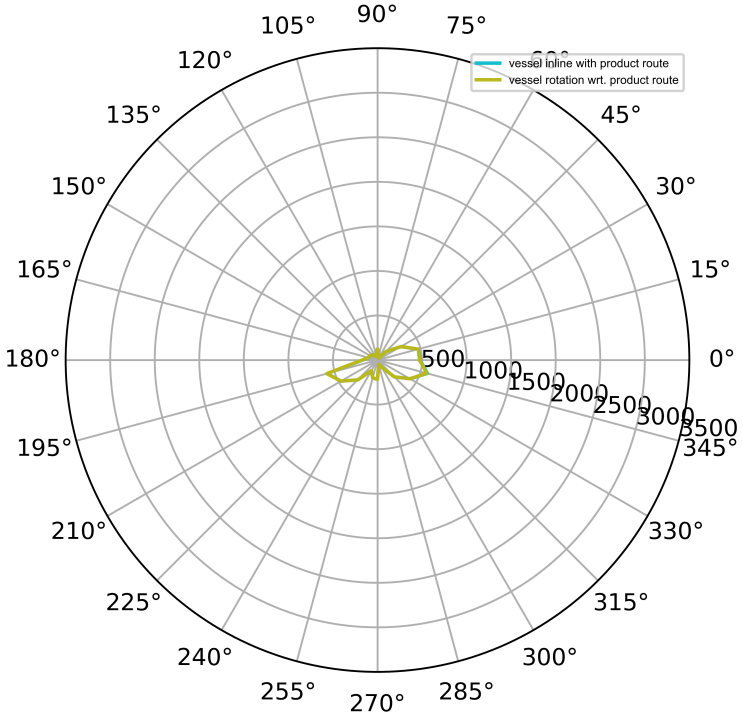
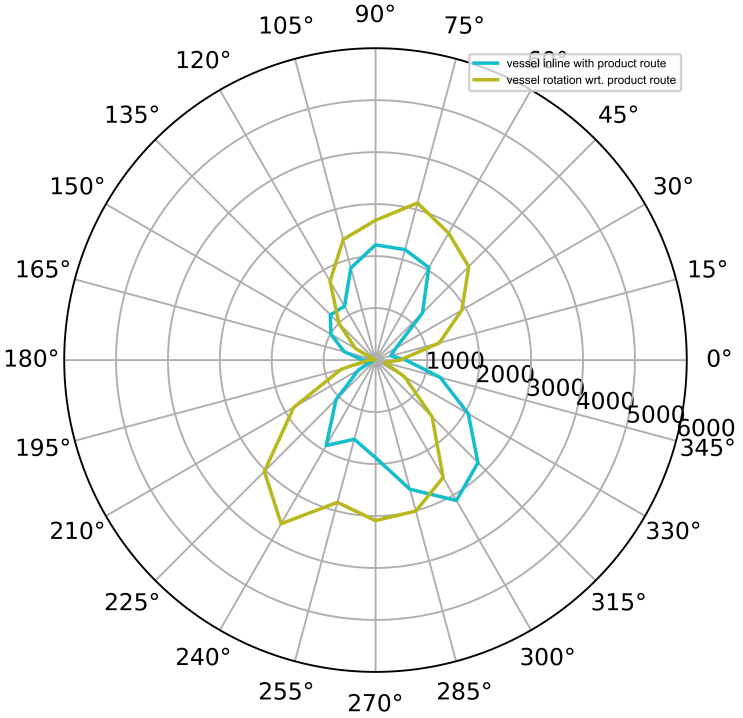


- TBA

Max Jacket Loads, FSTs 95% LNG, 100yr, LWL, Fy

- Two (2) struts contribute to each jacket global force

FST2



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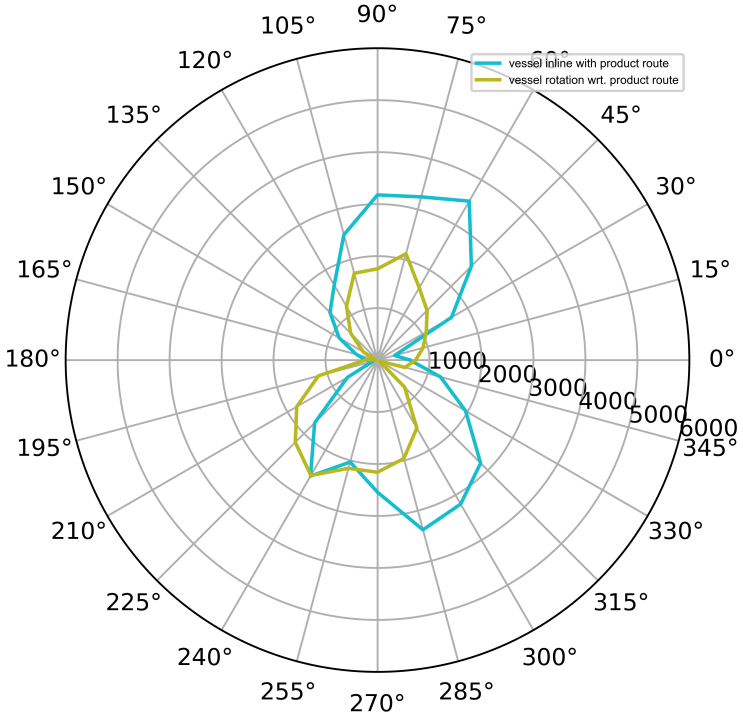
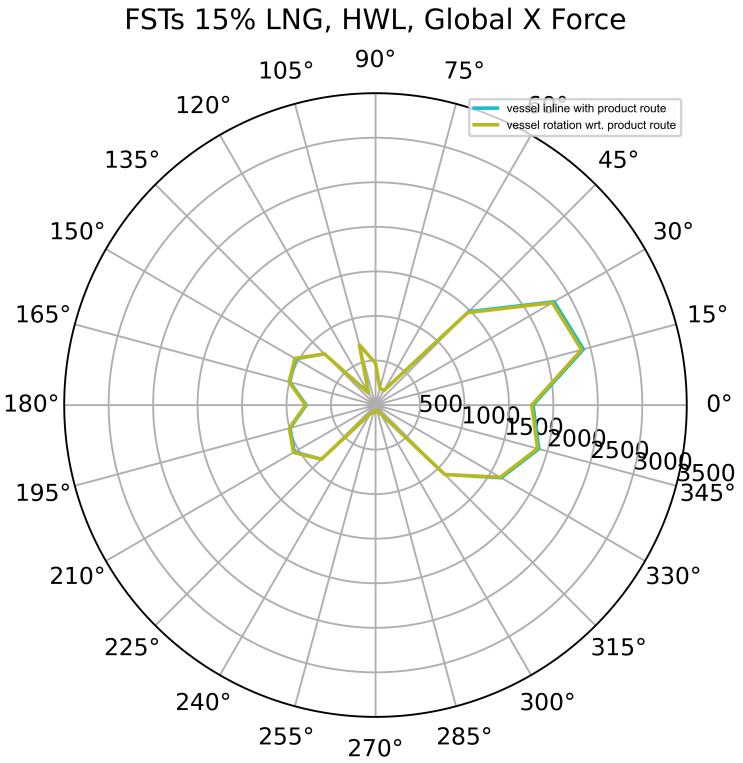


- TBA

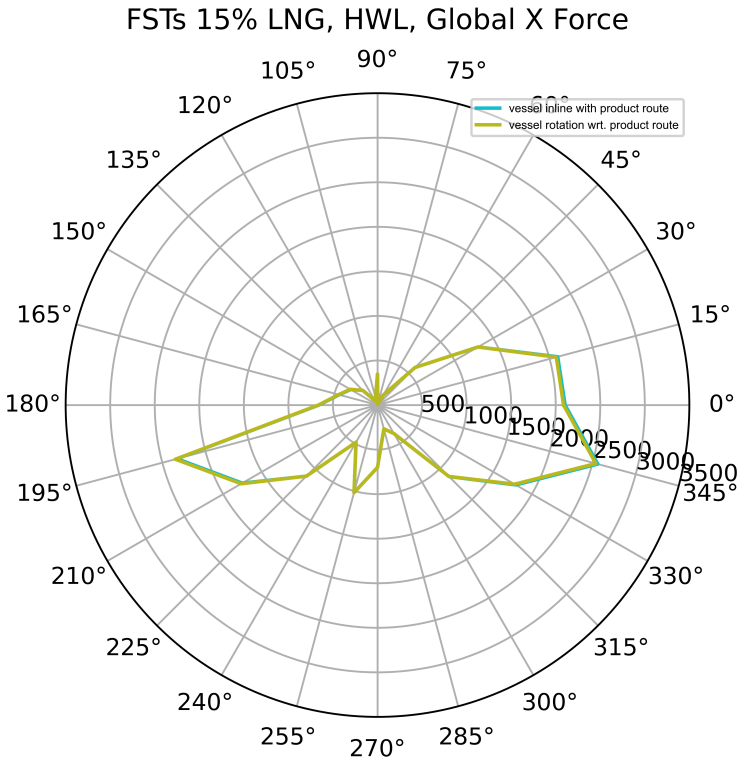
Max Jacket Loads, FSTs 95% LNG, 100yr, HWL, Fx

- Two (2) struts contribute to each jacket global force

FST2



FST1

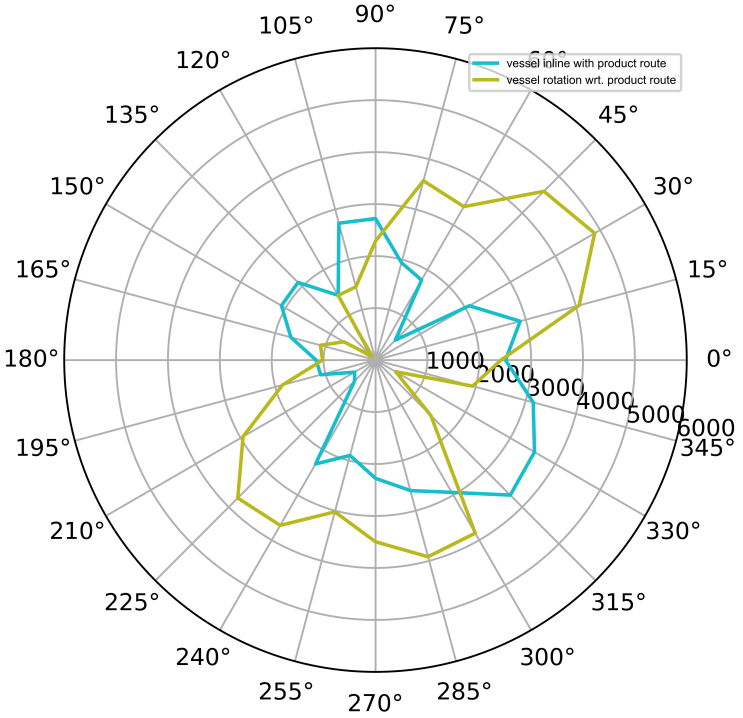


- TBA

Max Jacket Loads, FSTs 95% LNG, 100yr, HWL, Fy

- Two (2) struts contribute to each jacket global force

FST2



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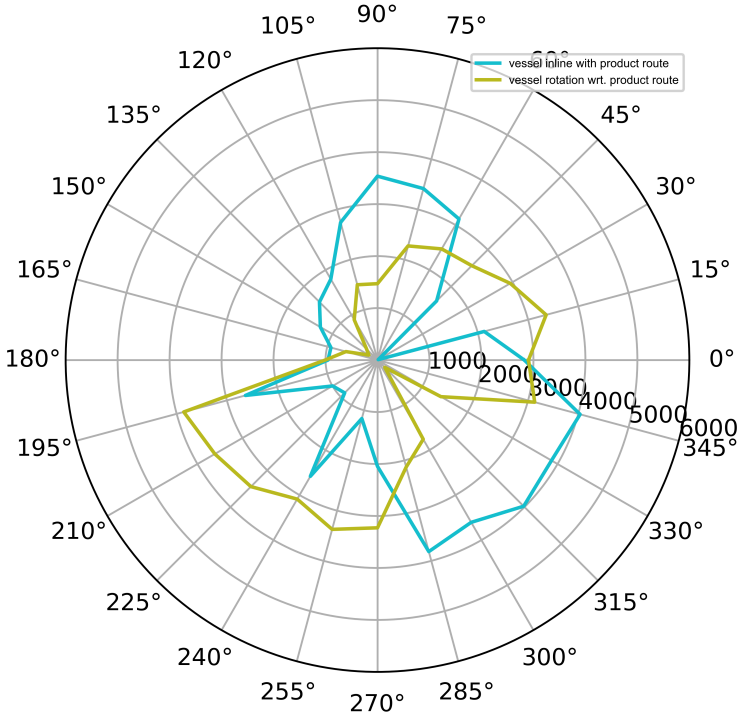
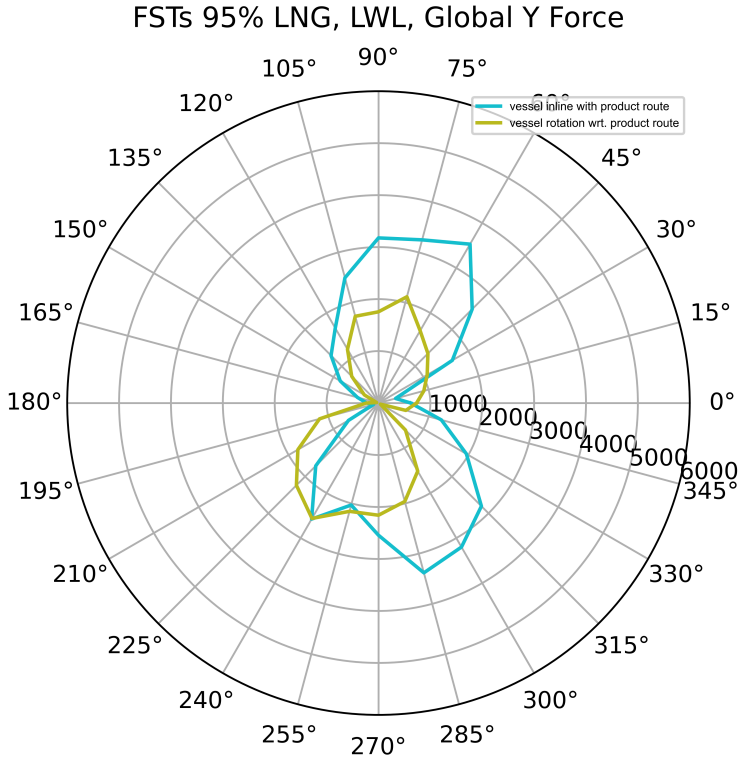


- TBA

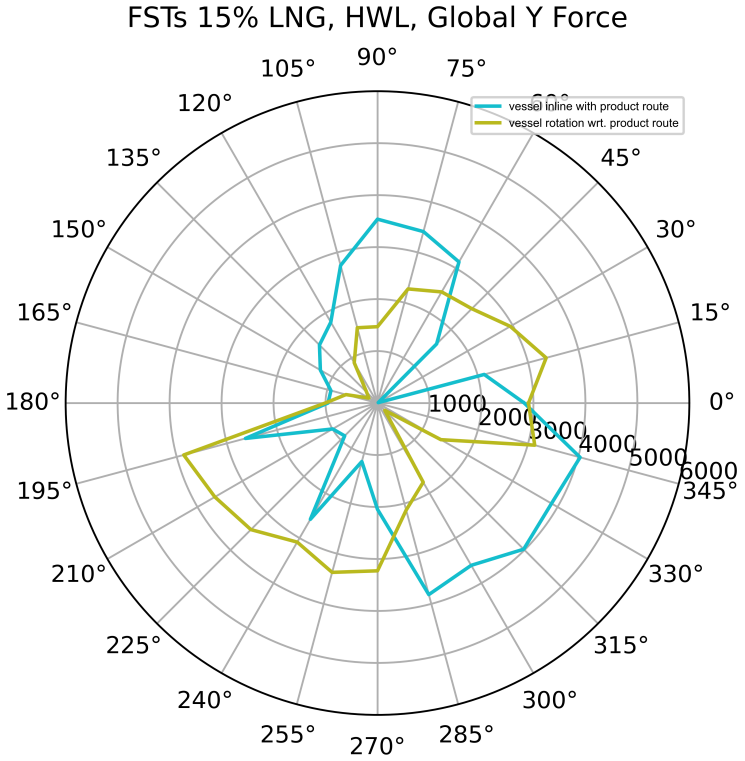
Max Jacket Loads, FST1, Fy

- Two (2) struts contribute to each jacket global force

FSTs 95% LNG, 100yr, LWL



FSTs 15% LNG, 100yr, HWL

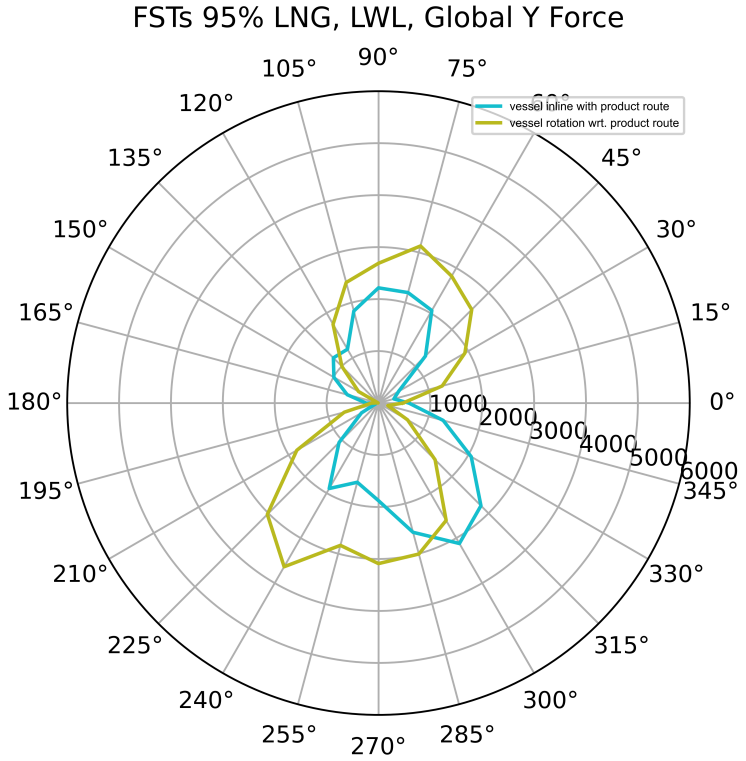


- TBA

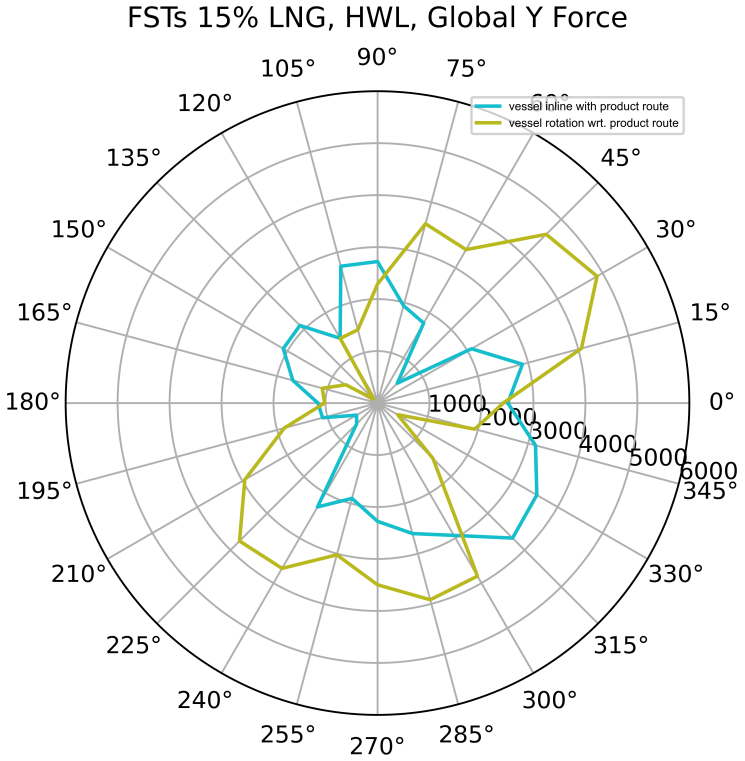
Max Jacket Loads, FST2, Fy

- Two (2) struts contribute to each jacket global force

FSTs 95% LNG, 100yr, LWL



FSTs 15% LNG, 100yr, HWL



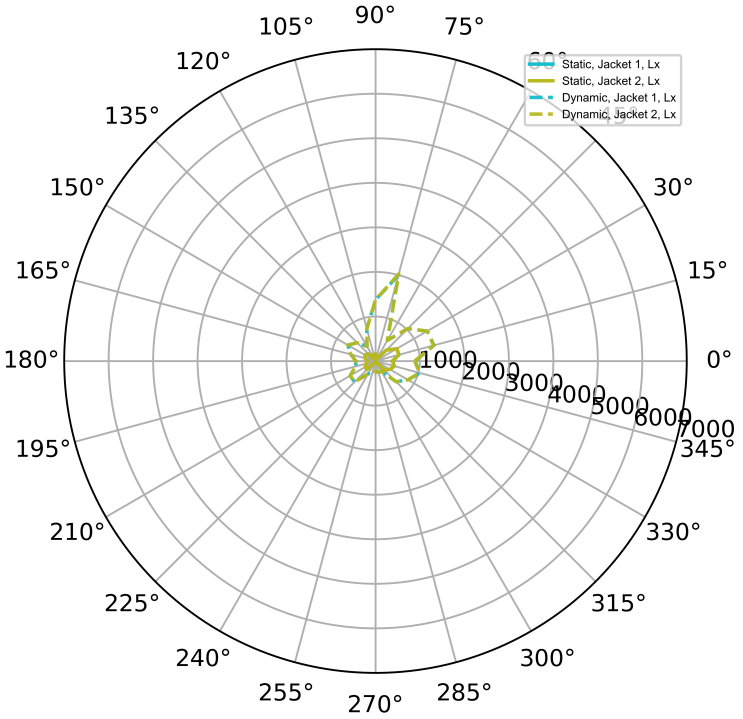
- TBA

Jacket Loads, Dynamic

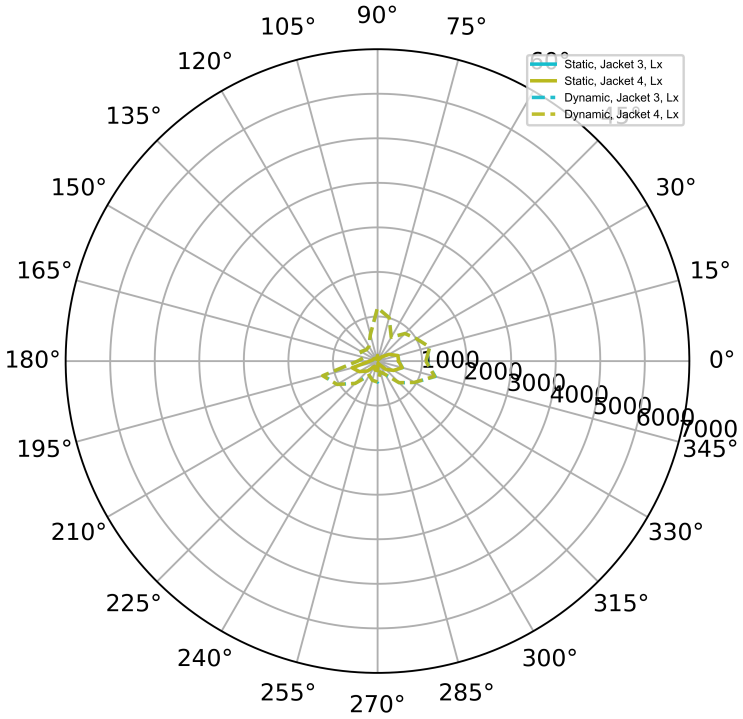
Max Jacket Loads, FSTs 95% LNG, 100yr, LWL, Fx

- Two (2) struts contribute to each jacket global force

FST2



FST1

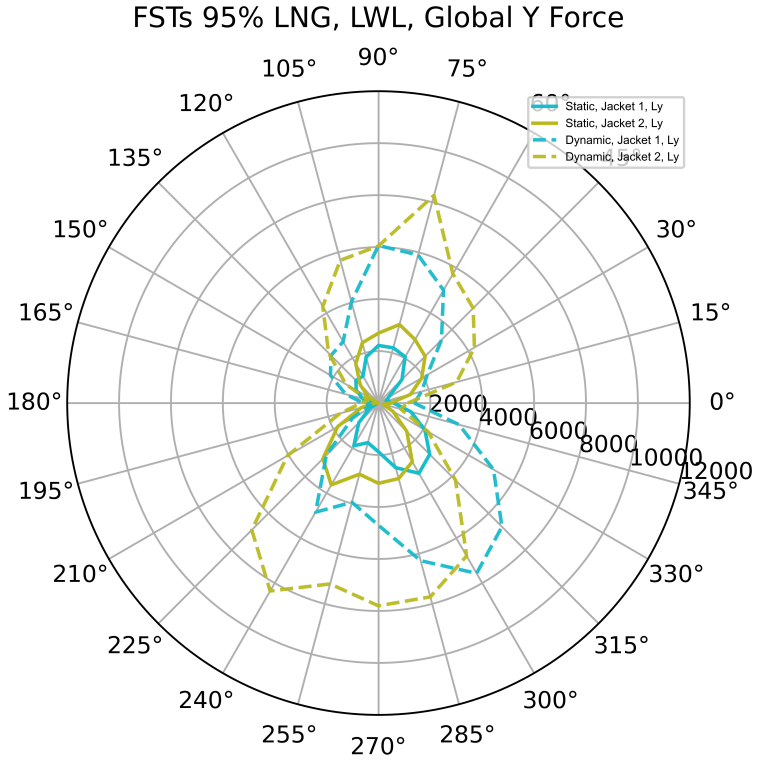


- TBA

Max Jacket Loads, FSTs 95% LNG, 100yr, LWL, Fy

- Two (2) struts contribute to each jacket global force

FST2



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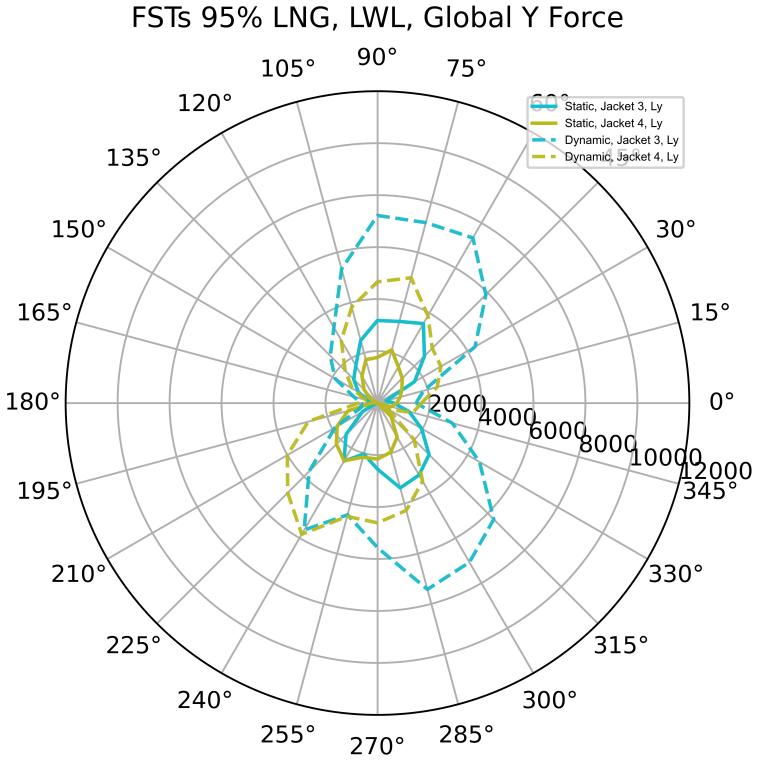
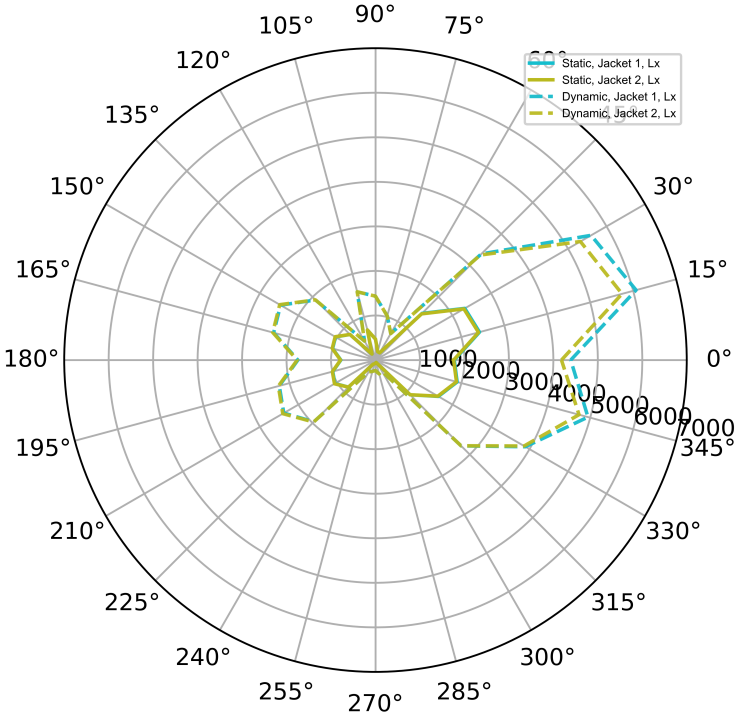


- TBA

Max Jacket Loads, FSTs 95% LNG, 100yr, HWL, Fx

- Two (2) struts contribute to each jacket global force

FST2



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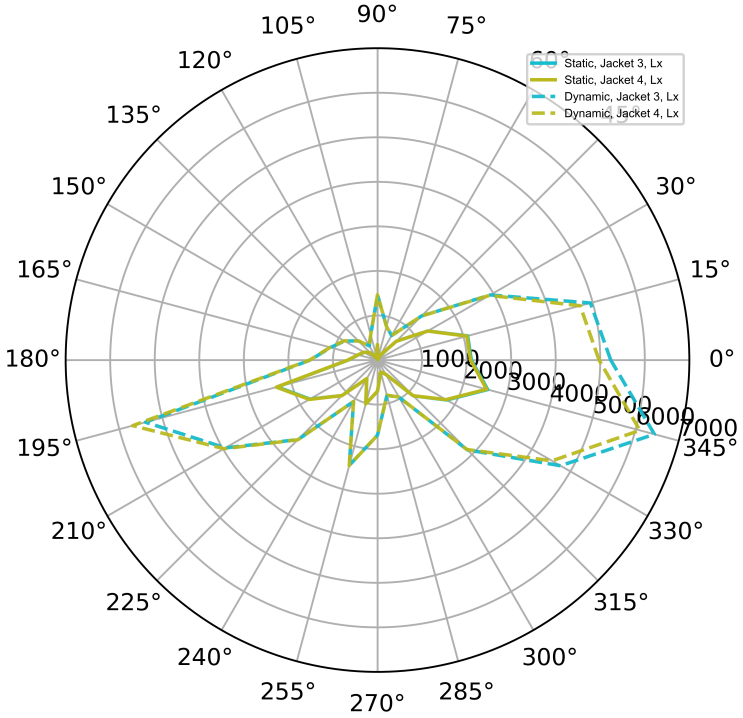

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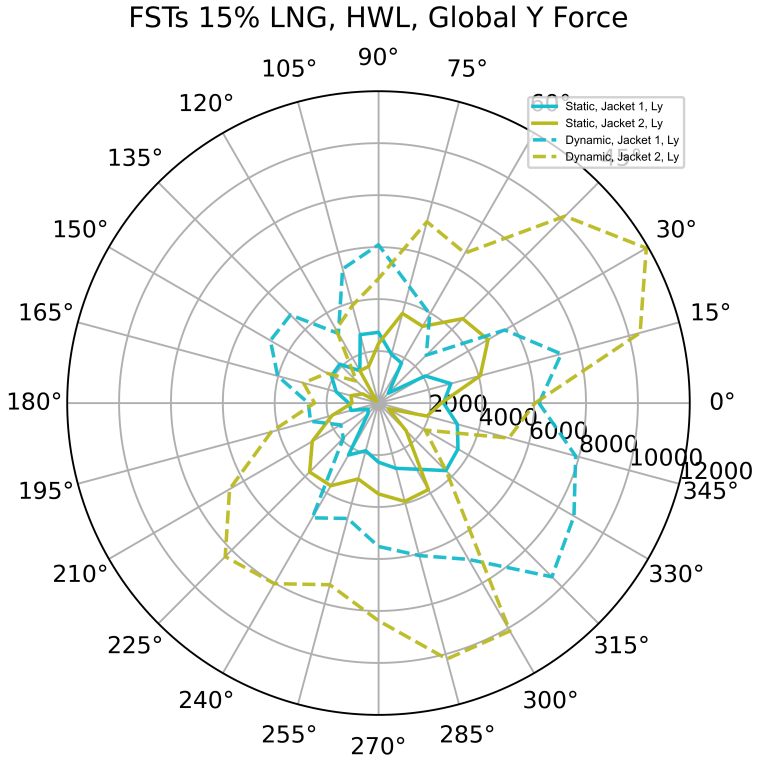
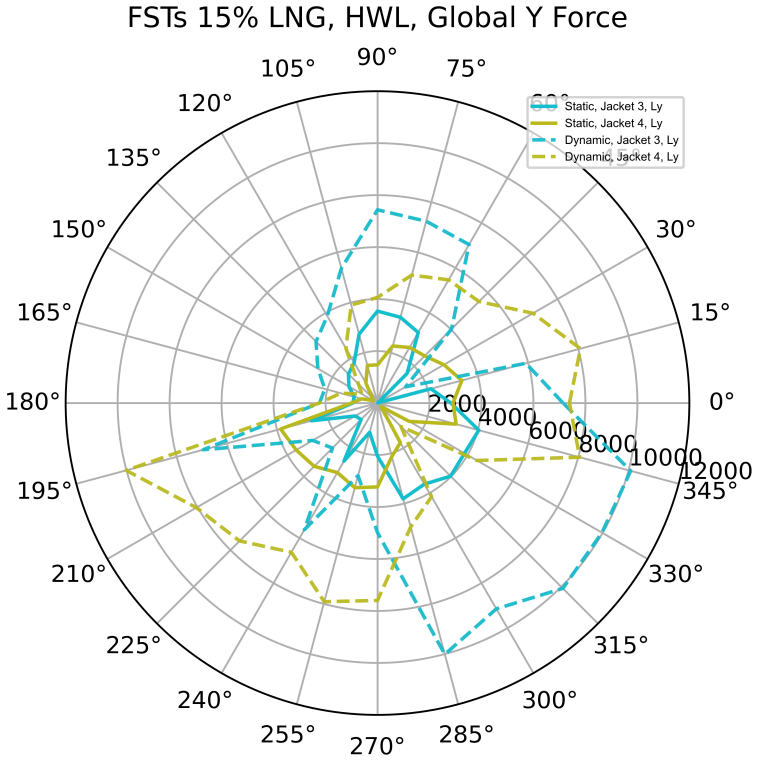
Max Jacket Loads, FSTs 95% LNG, 100yr, HWL, Fy

- Two (2) struts contribute to each jacket global force

FSTs 95% LNG, 100yr, LWL



FSTs 15% LNG, 100yr, HWL

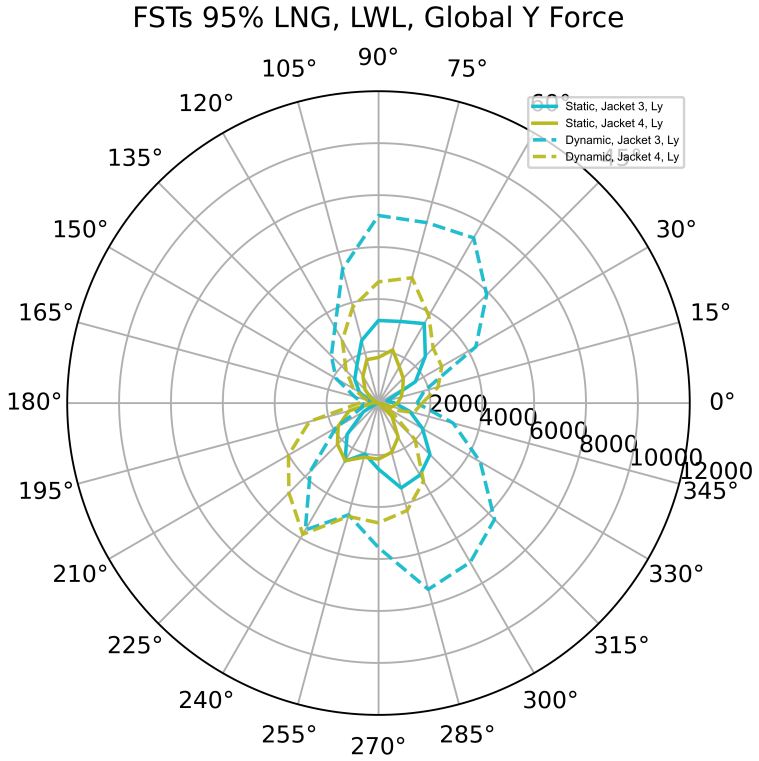


- TBA

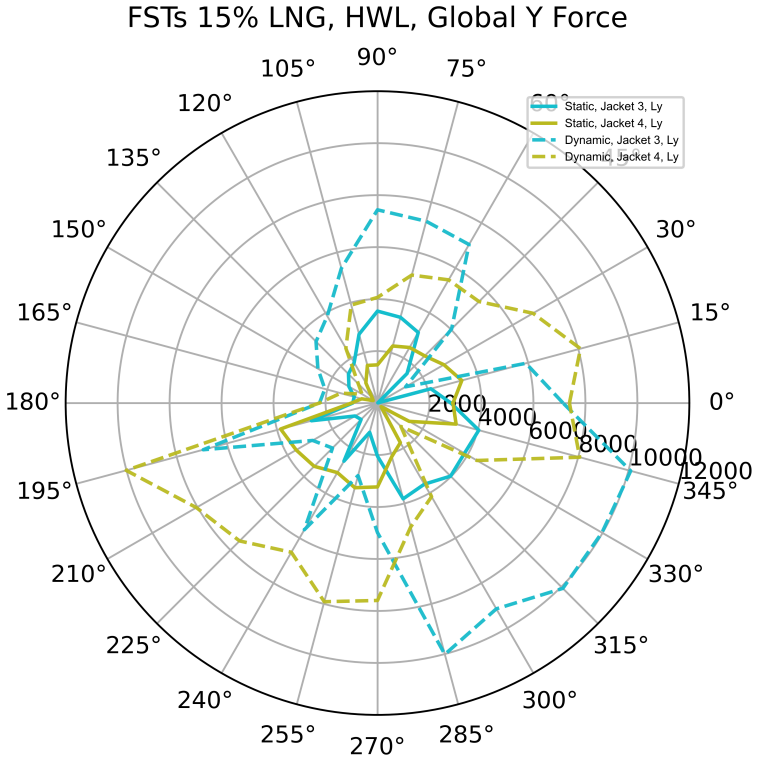
Max Jacket Loads, FST1, Fy

- Two (2) struts contribute to each jacket global force

FSTs 95% LNG, 100yr, LWL



FSTs 15% LNG, 100yr, HWL

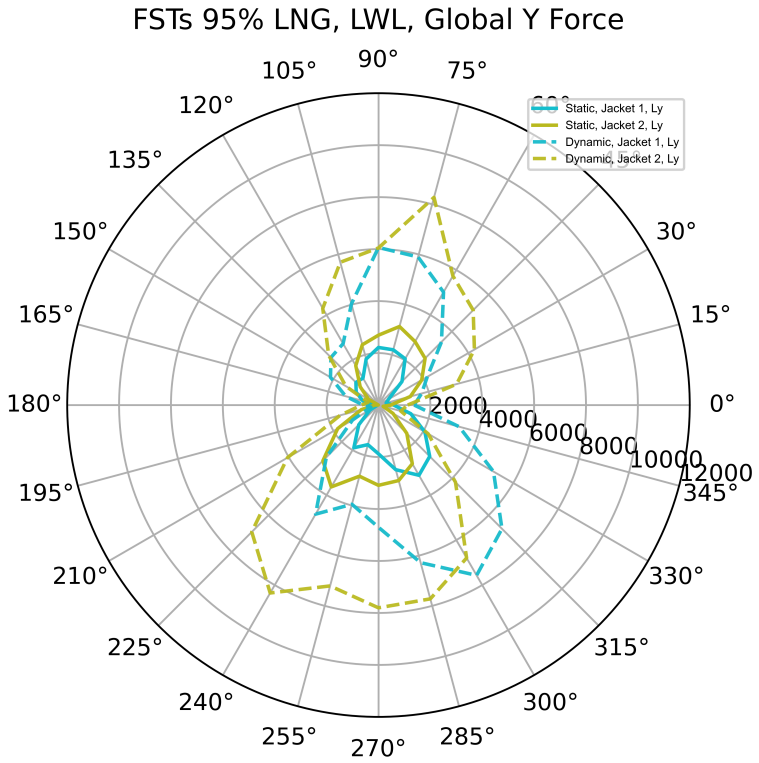


- TBA

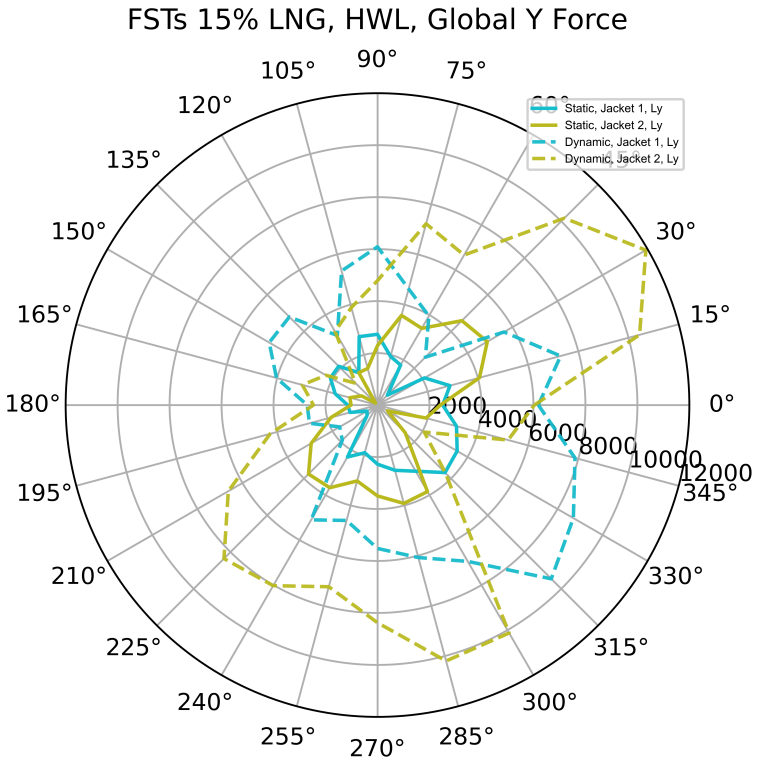
Max Jacket Loads, FST2, Fy

- Two (2) struts contribute to each jacket global force

FSTs 95% LNG, 100yr, LWL



FSTs 15% LNG, 100yr, HWL



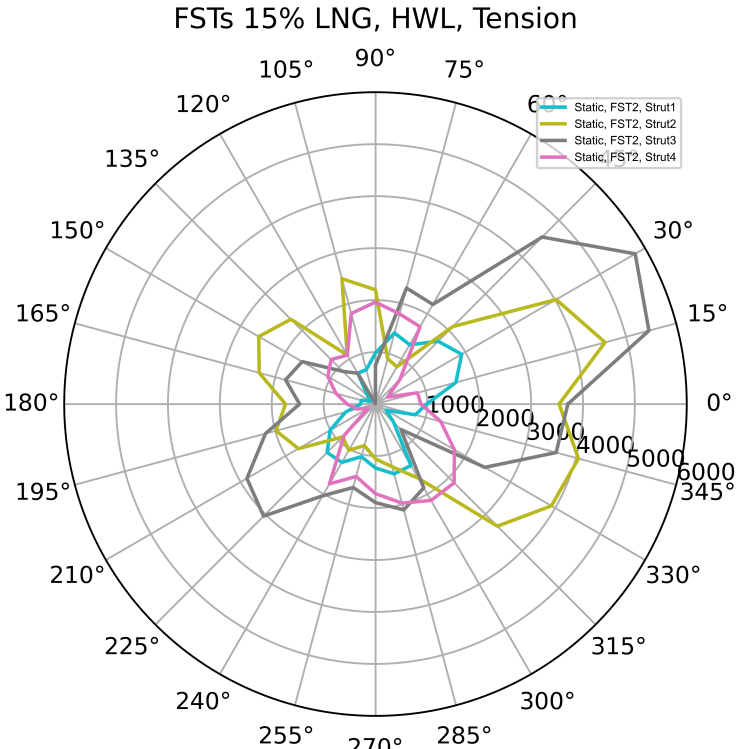
- TBA

Strut Loads, Static

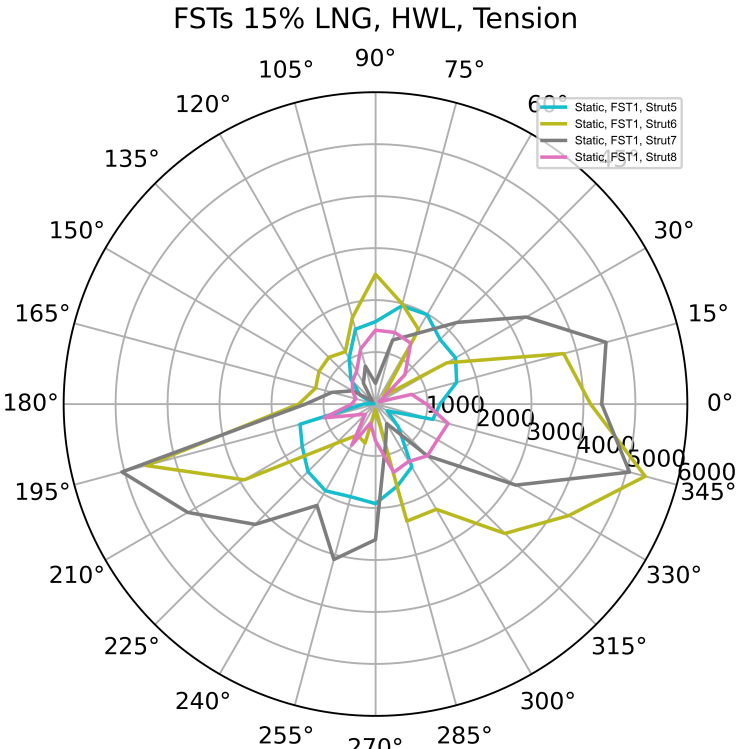
Max Strut Loads, FSTs 95% LNG, 100yr, HWL, Tension, Static

- TBA

FST2



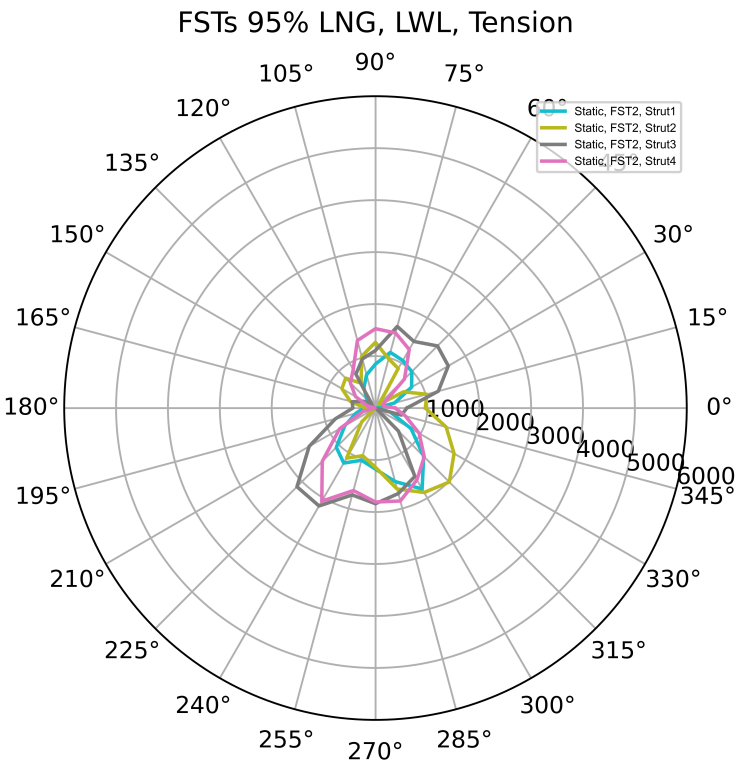
FST1



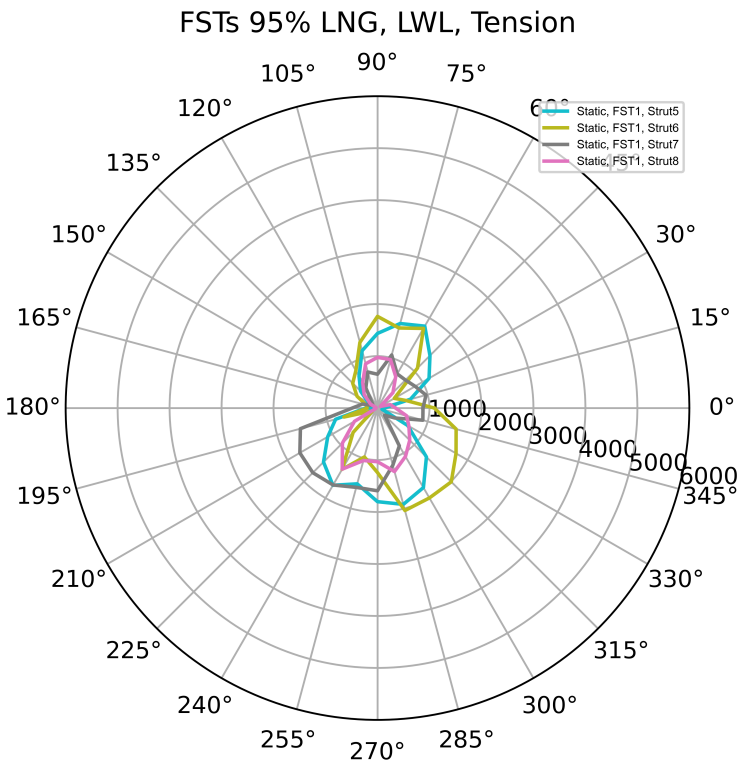
Max Strut Loads, FSTs 95% LNG, 100yr, LWL, Tension, Static

- TBA

FST2



FST1

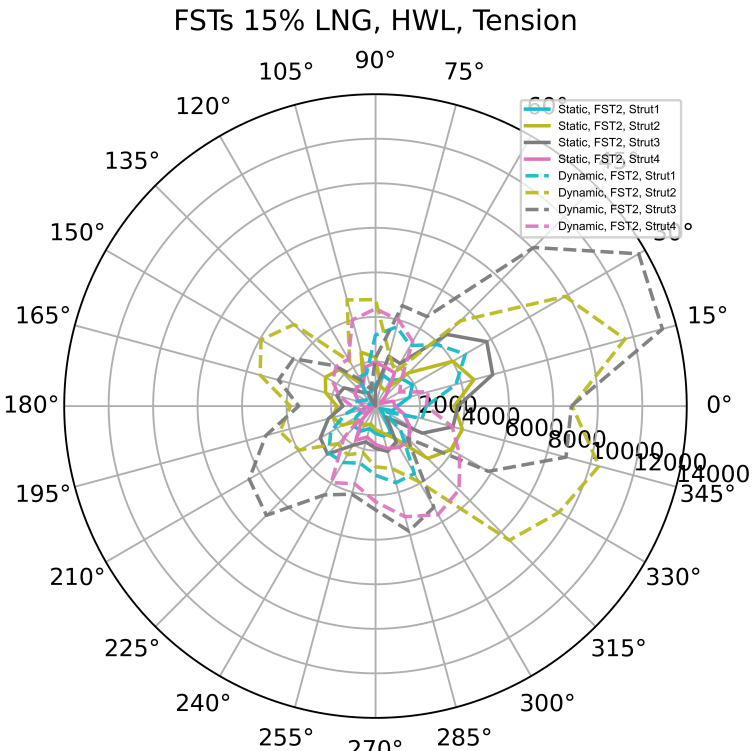


Strut Loads, Dynamic

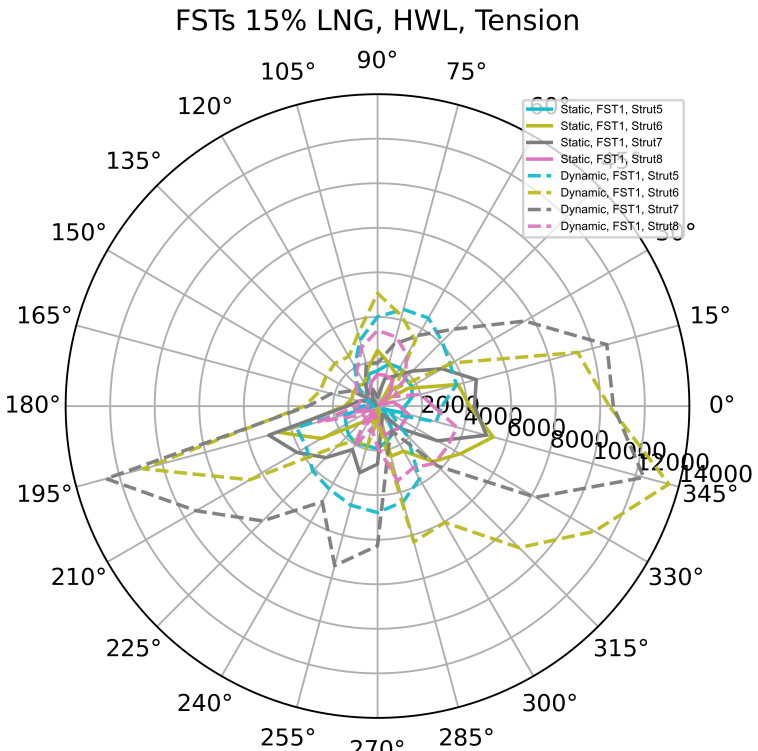
Max Strut Loads, FSTs 95% LNG, 100yr, HWL, Tension, Dynamic

- TBA

FST2



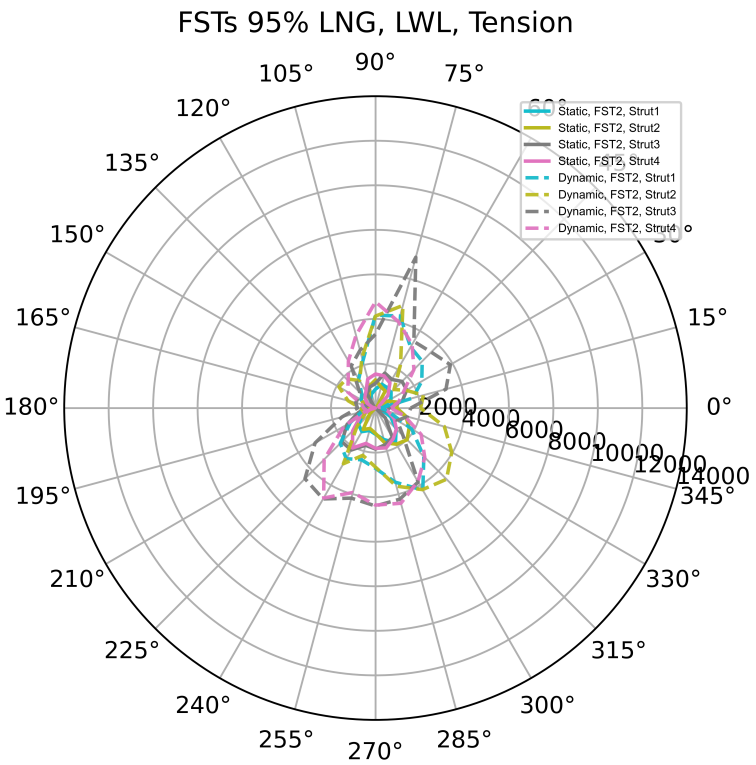
FST1



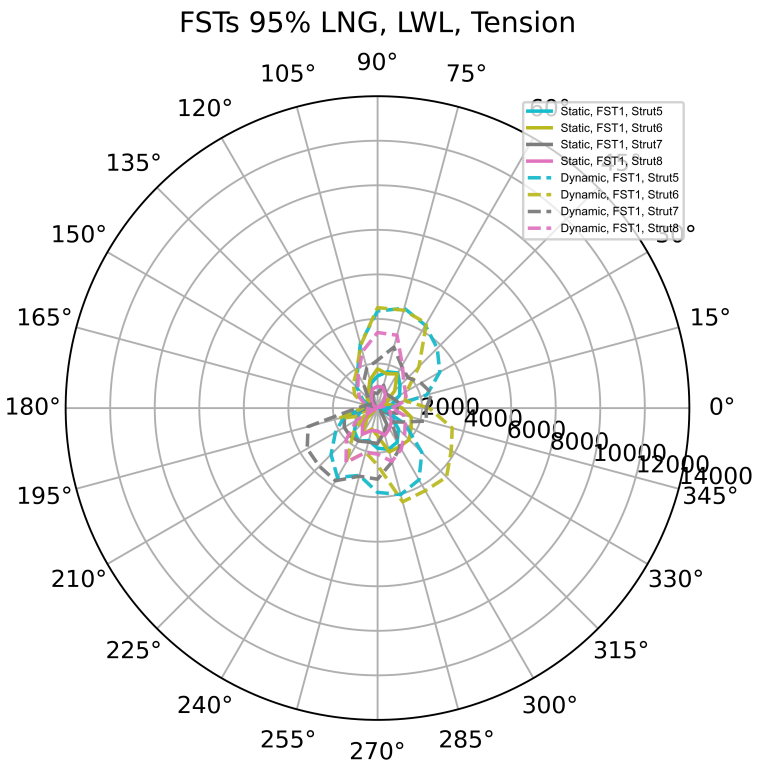
Max Strut Loads, FSTs 95% LNG, 100yr, LWL, Tension, Dynamic

- TBA

FST2

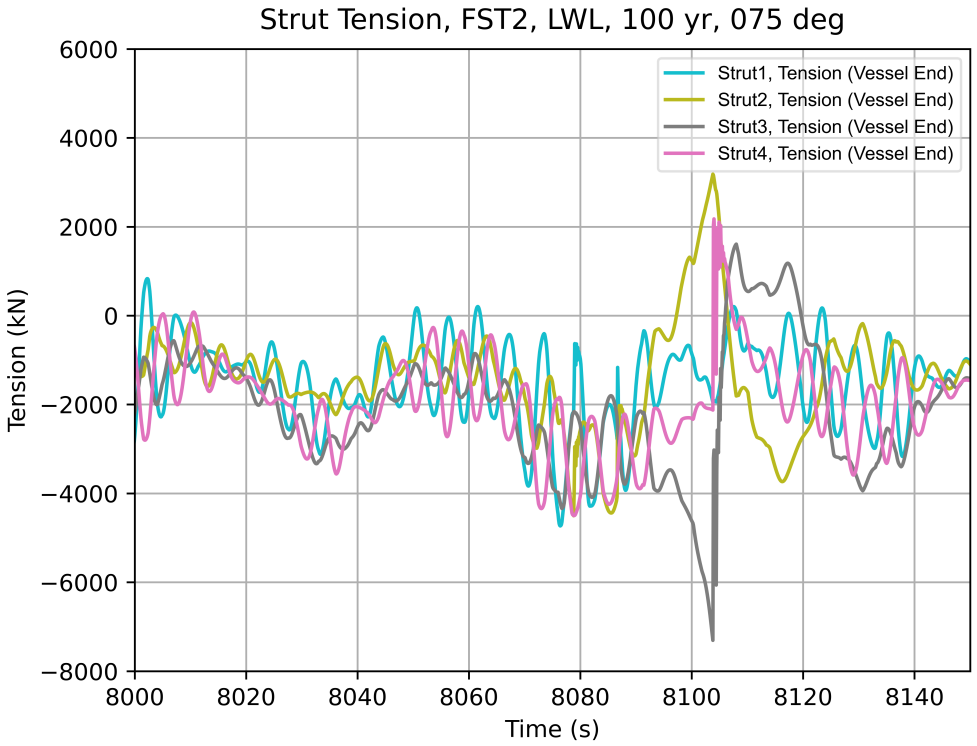


FST1

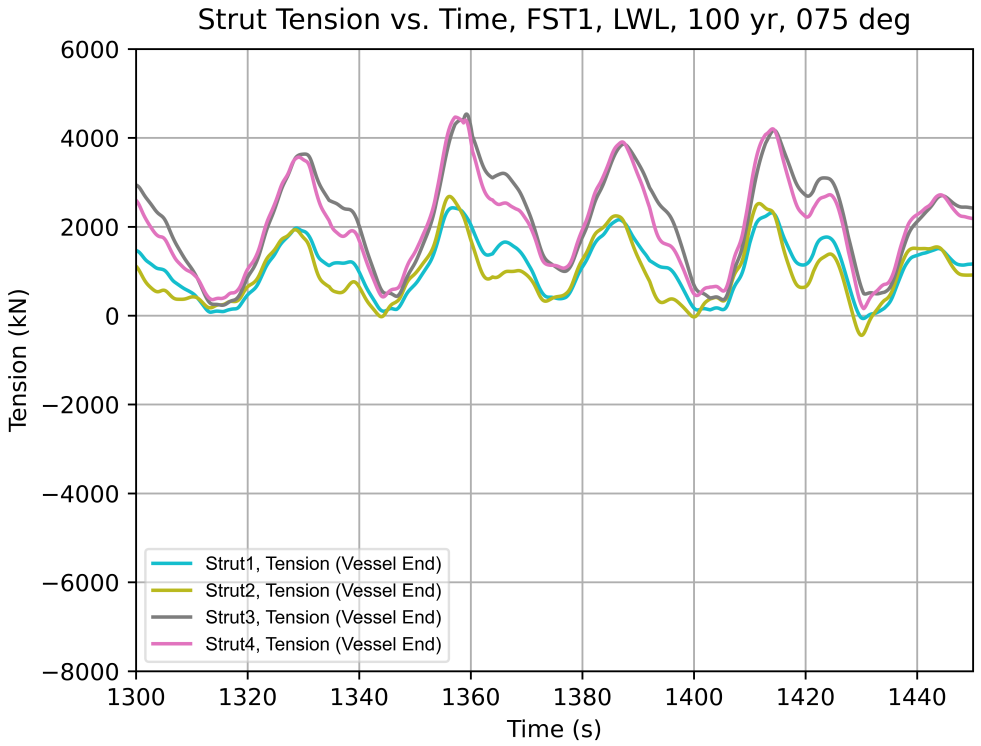


FSTs 95% LNG, 100yr, LWL - Force Timetrace

Min -ve



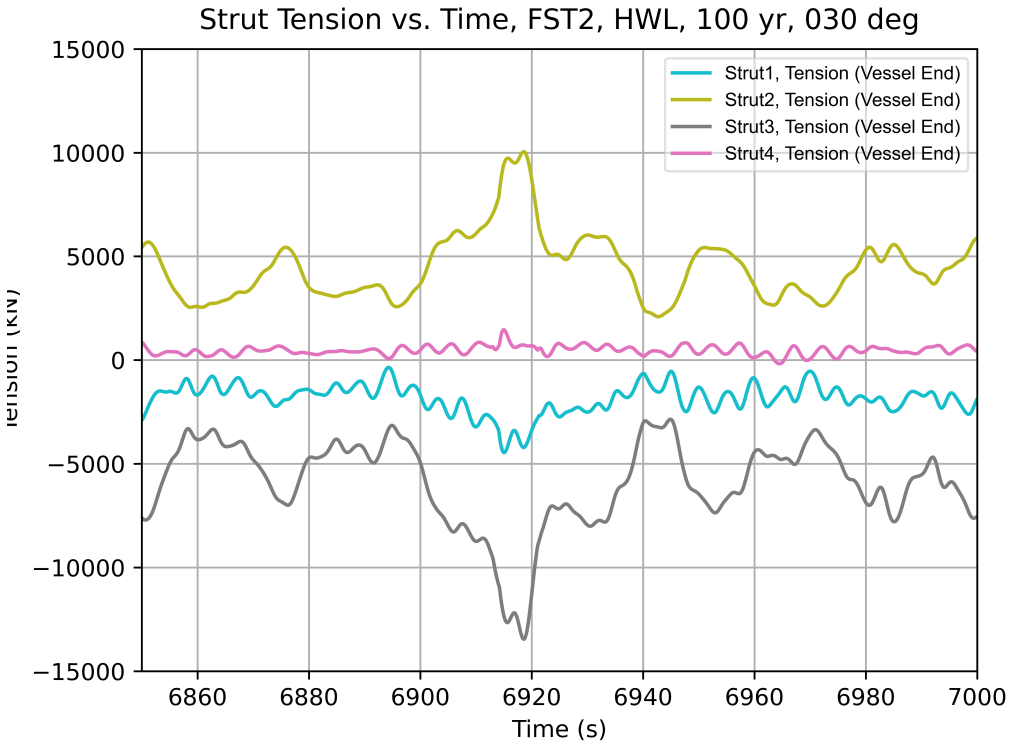
Max +ve



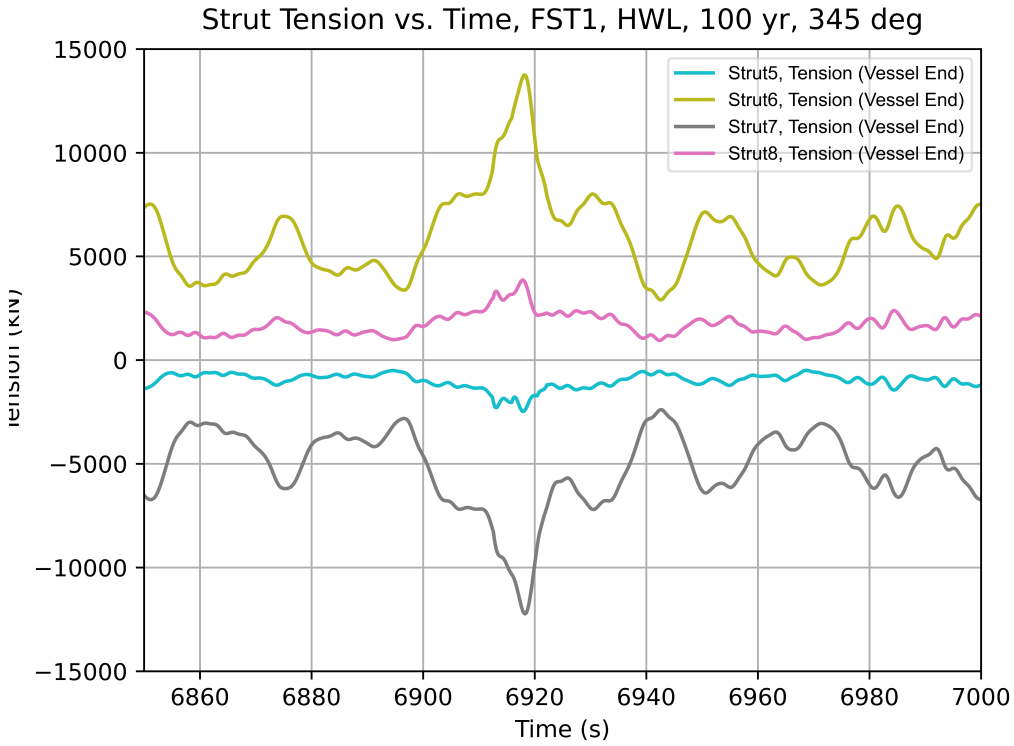
- The struts are in sync
- Results in lower strut forces when compared to HWL results

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

Min -ve



Max +ve



- The 2 struts pairs are locked FST in tension-compression position
  - Results in high strut forces for FSTs 15% LNG, LWL condition
- This tension-compression lock position is similar to what was obtained in AQWA

FSTs, 100yr Discussion

- 100yr, HWL has tension-compression lock position
  - potentially due to force coefficients used
  - Perform sensitivity analysis with wind force yaw-coefficients = 0
  - Perform timestep senstivity with 0.05s and 0.025s. Current timestep is 0.1s.
- Determine whether tension-compression lock position is realistic due to prevailing external static loads (e.g. wind, current, wave etc.)

Conclusions

Way Forward

- FST tension-compression lock position
  - Theorically, this effect may be possible.
  - Recommend permanemnt 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 QA/QC (Ongoing)
- 5 yr FSTs with LNGC
    - Will get this running after few more insights in 100 yr analysis