

# **WLNG FST Engineering Completion**

## **WLNG FST Extreme Weather Analysis**

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2025-01-31

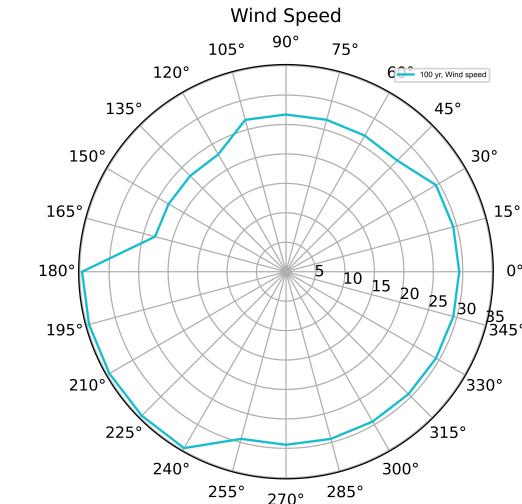
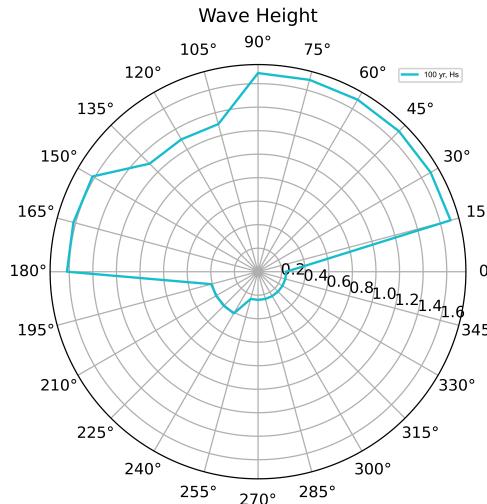
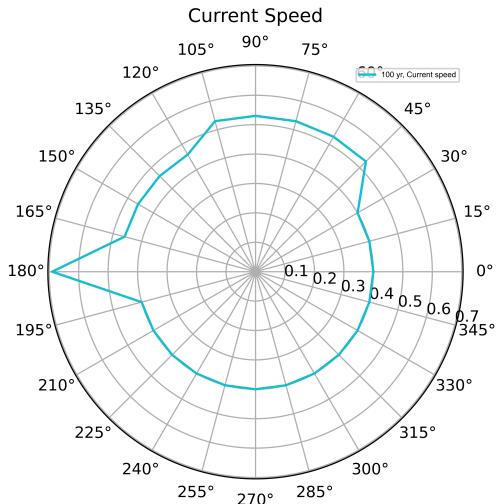
# Introduction

- FST analysis for WLNG

**Design Data**

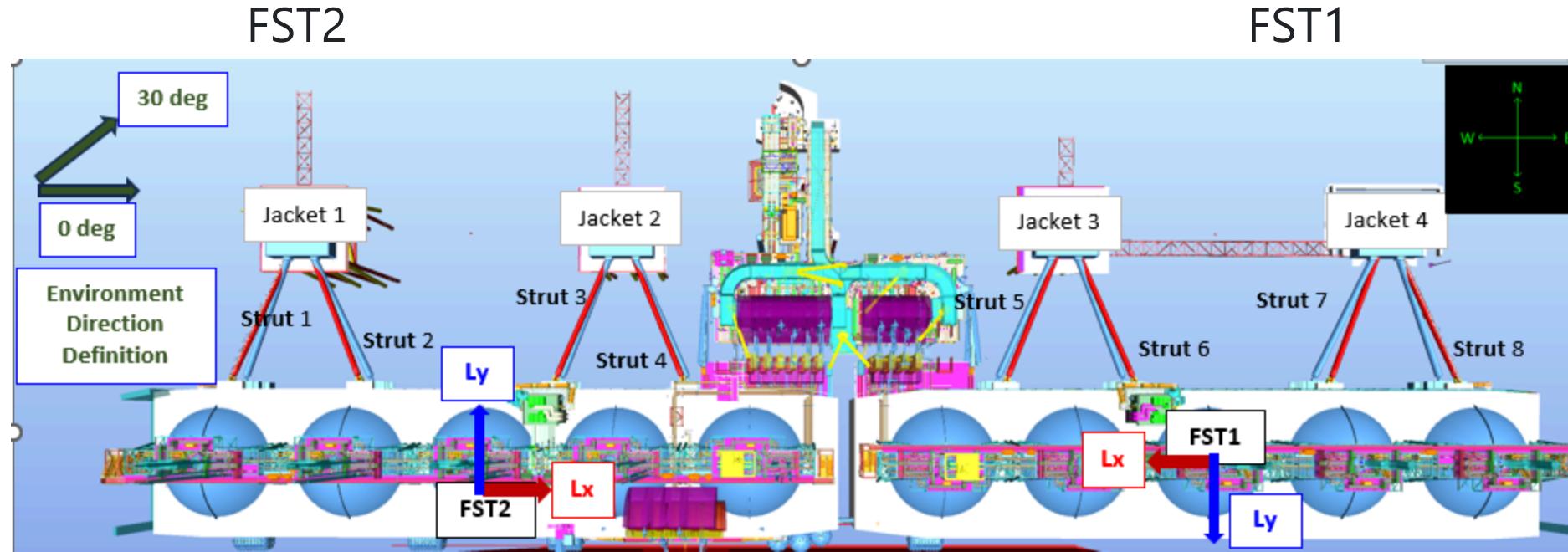
**Analysis Methodology**

# Design Data - Environment



- All radial plots are given with Wind direction
- The associated wave and current magnitude and direction are used. Refer to Metocean report for details.

# 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 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))

- Applicable details will be added to each slide

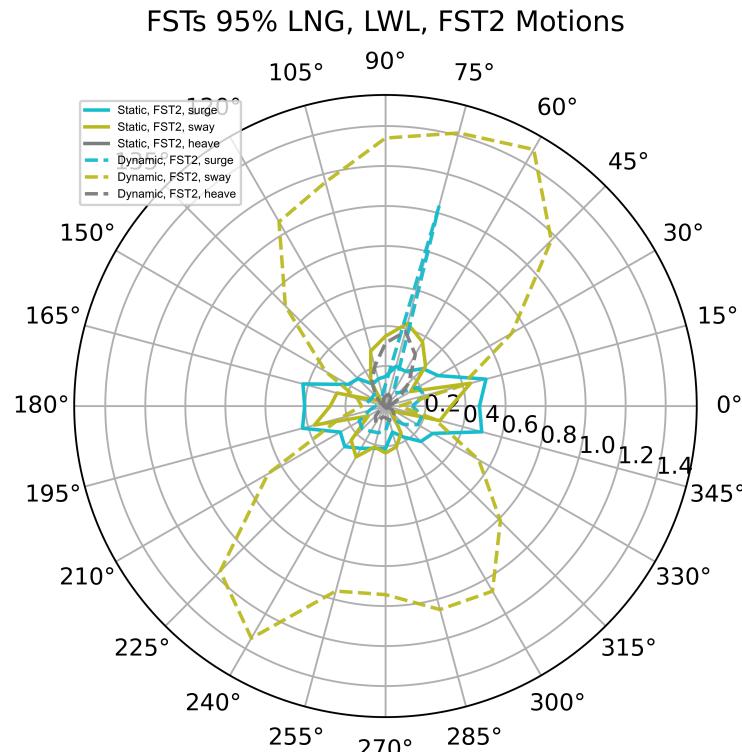
# **100 year Analysis Results**

# FST Motion Response

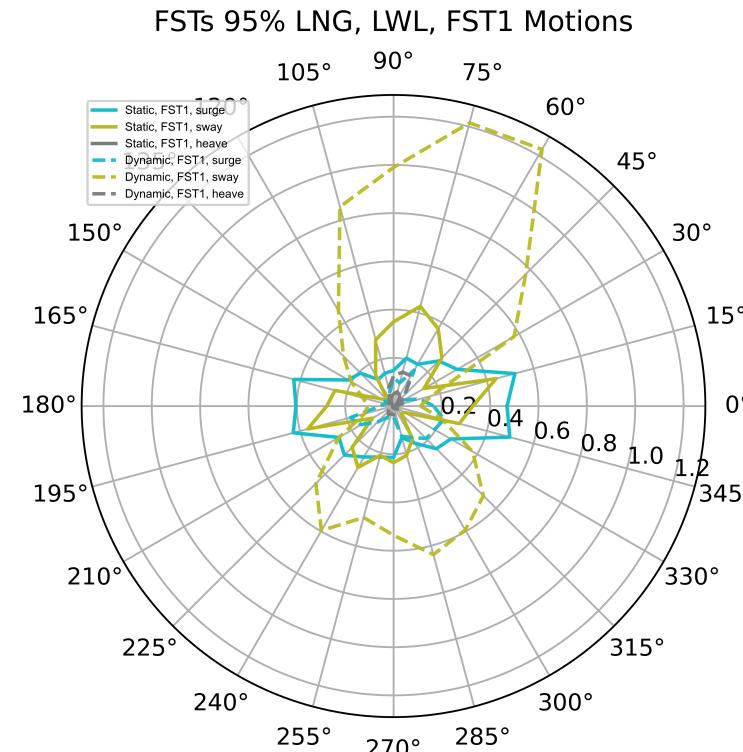
# FSTs 95% LNG, 100yr, LWL - FST Surge and Sway

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FST2



FST1

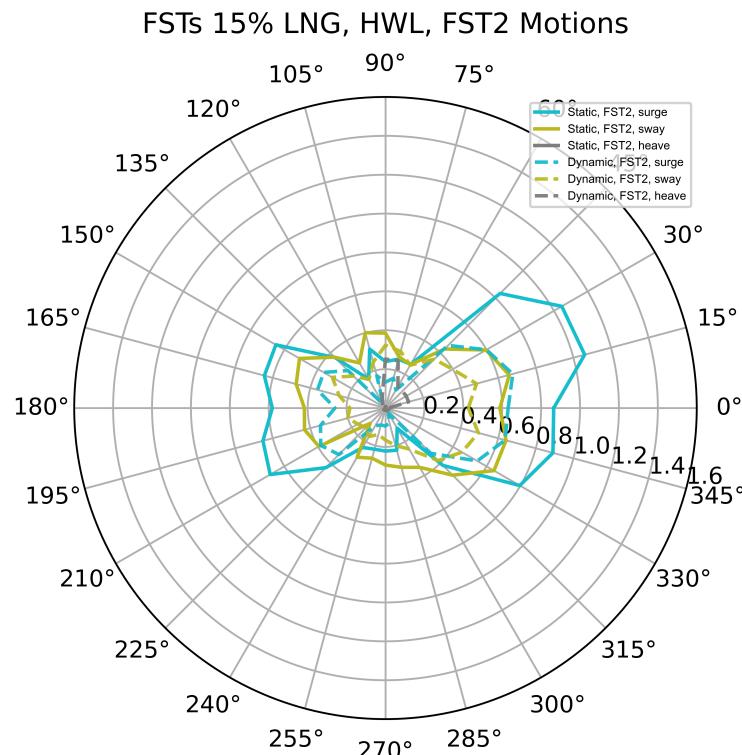


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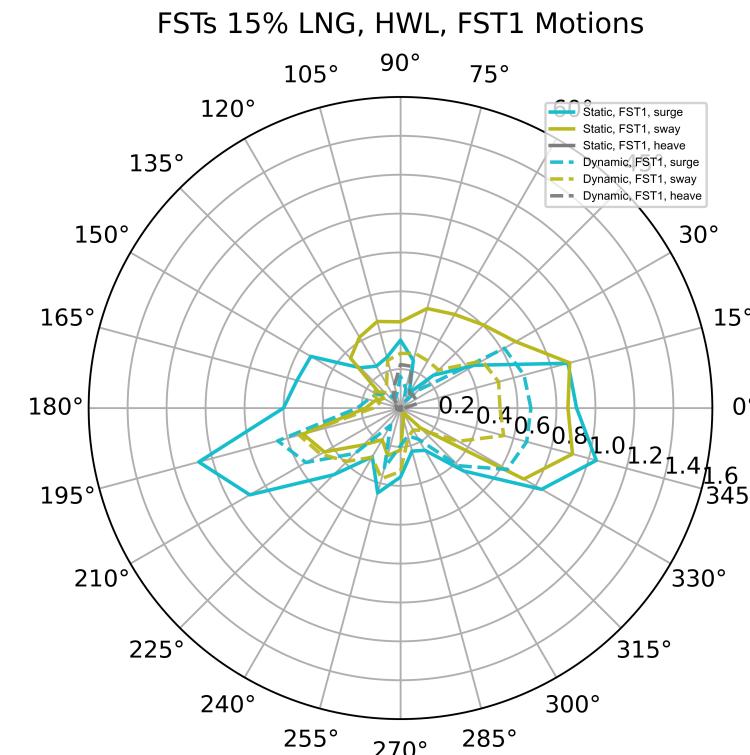
# FSTs 95% LNG, 100yr, HWL - FST Surge and Sway

- TBA

FST2



FST1

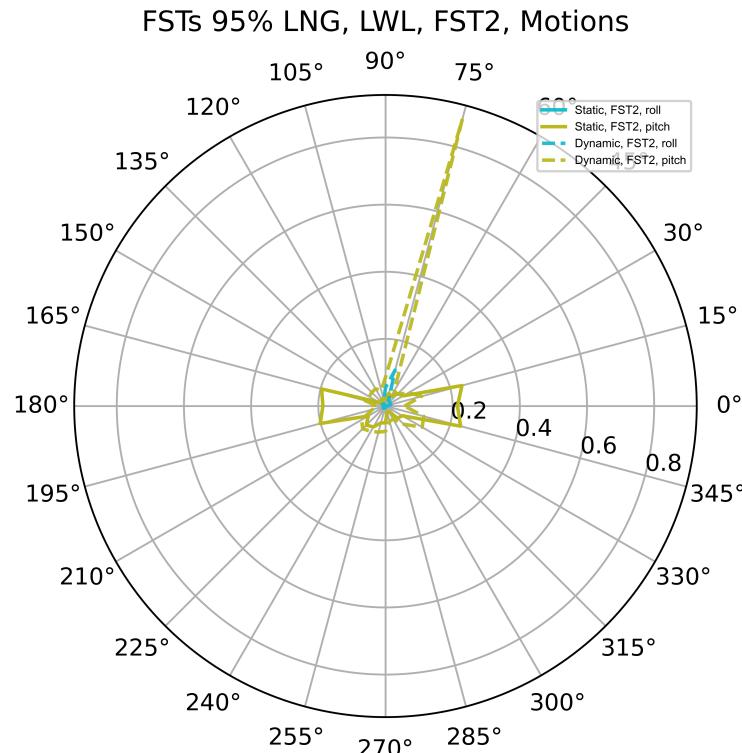


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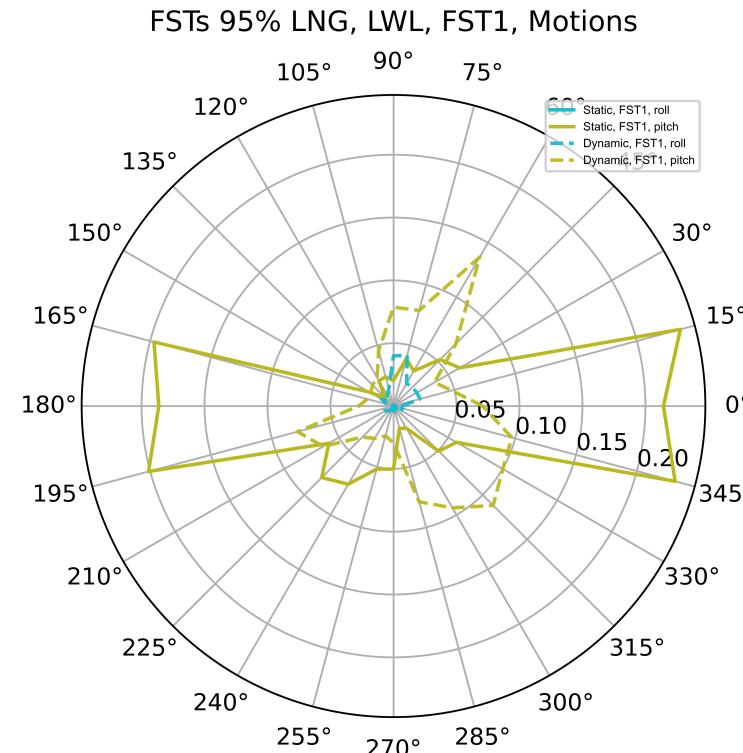
# FSTs 95% LNG, 100yr, LWL - FST Rotations

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FST2



FST1

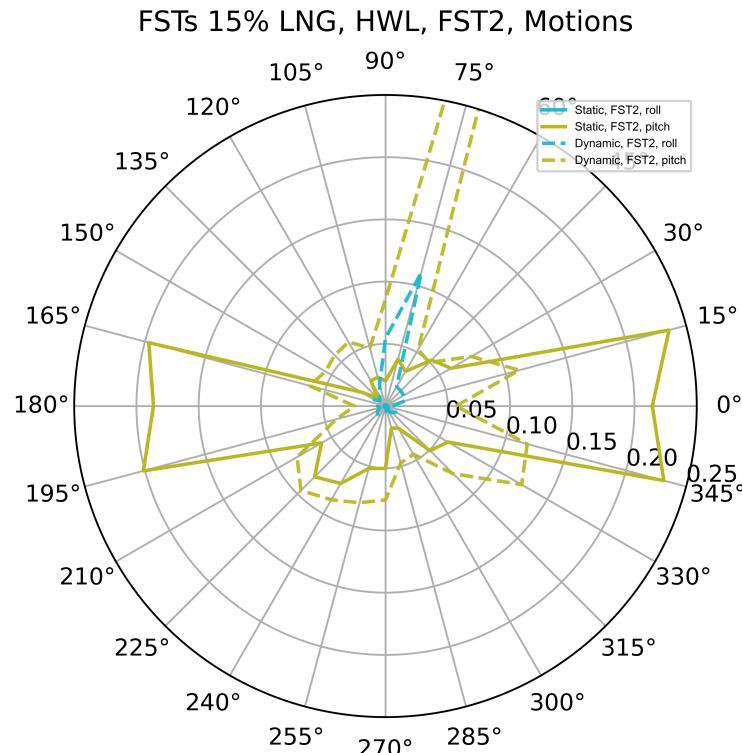


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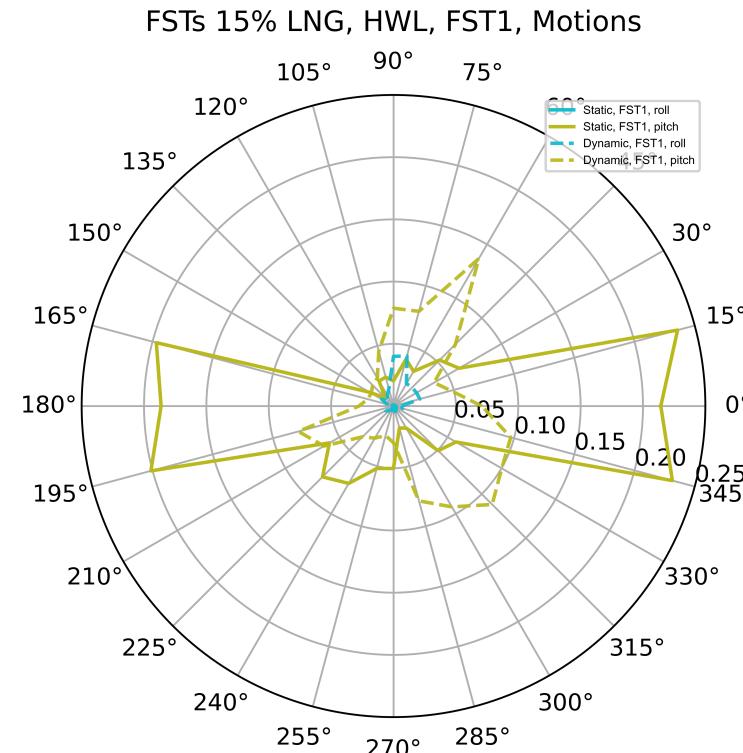
# FSTs 95% LNG, 100yr, HWL - FST Rotations

- TBA

FST2



FST1



- TBA

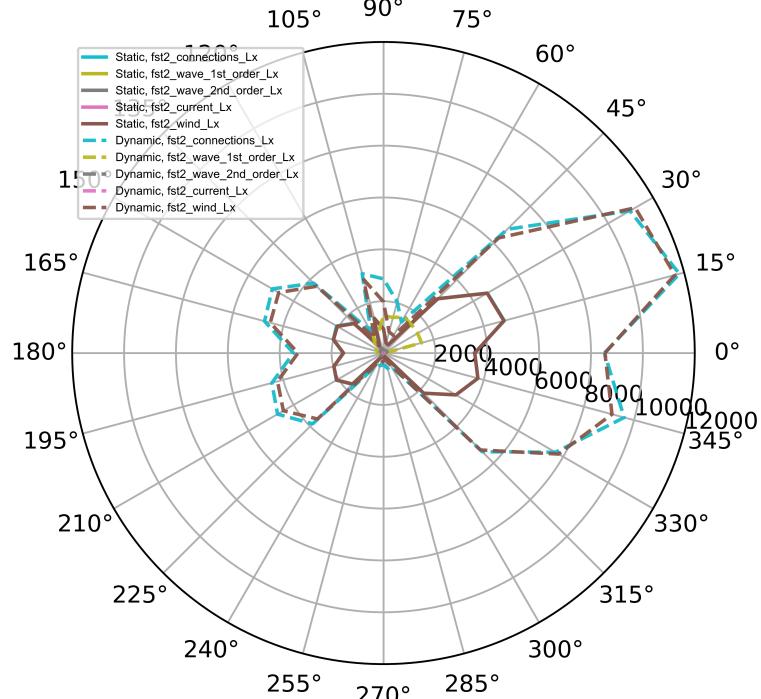
# FST Load Response

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

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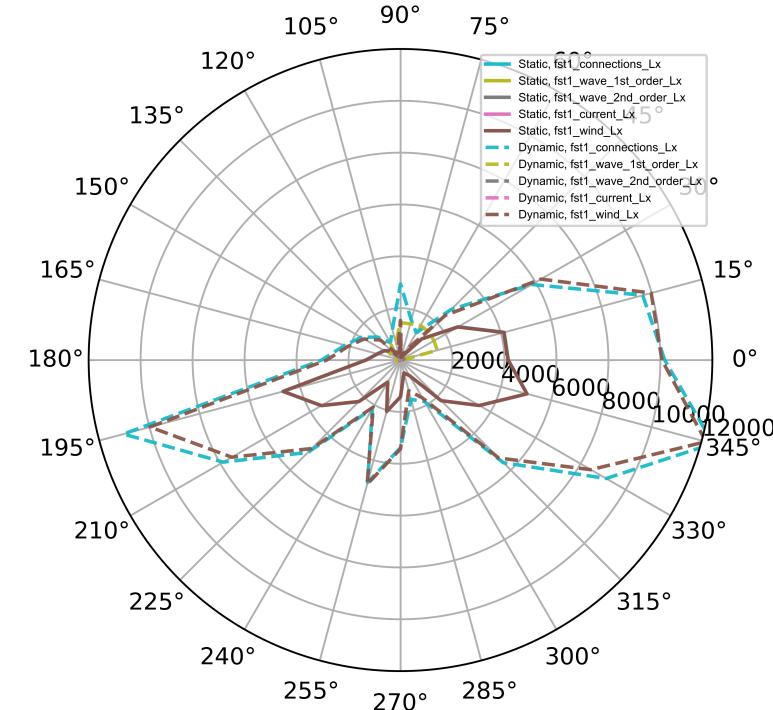
FST2

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



FST1

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



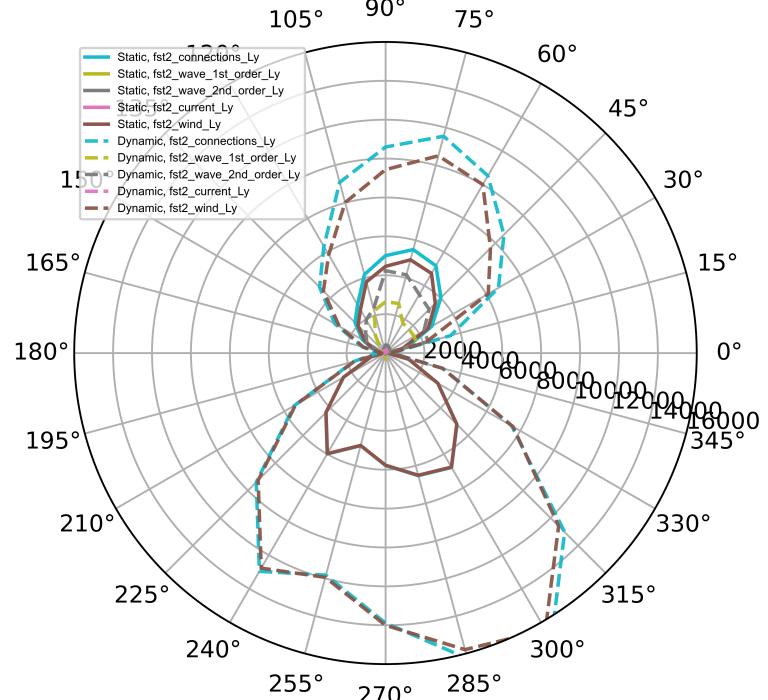
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# FSTs 95% LNG, 100yr, HWL, FST Forces, Y Direction

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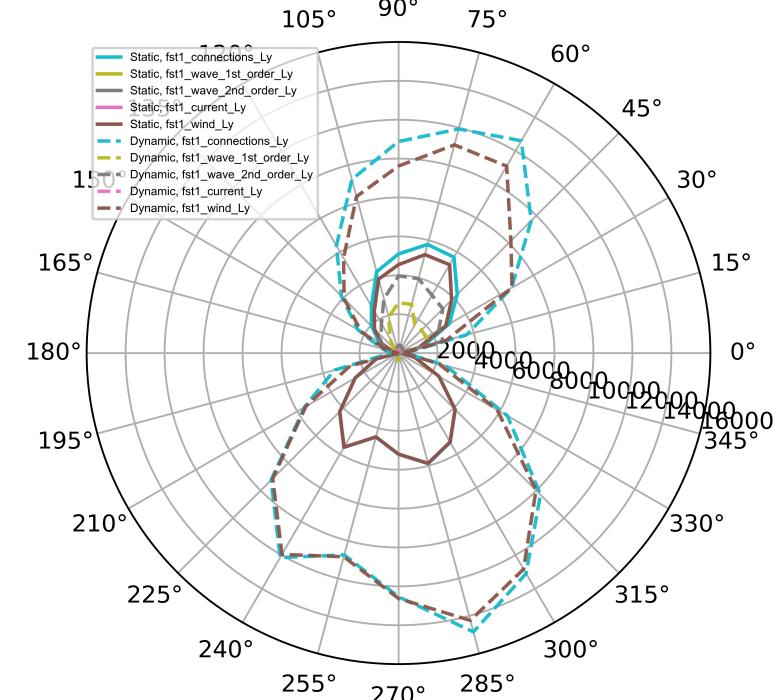
## FST2

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



## FST1

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



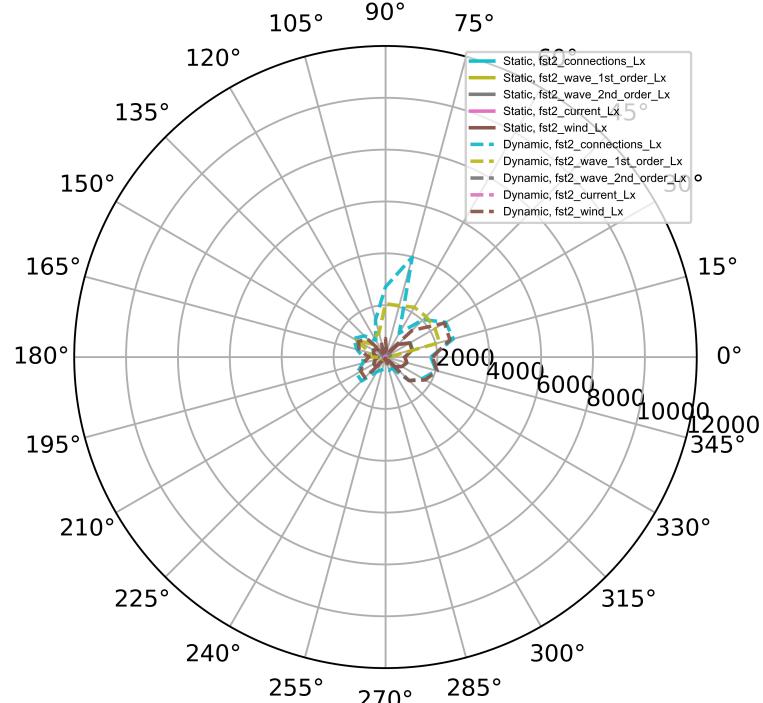
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# FSTs 15% LNG, 100yr, LWL, FST Forces, X Direction

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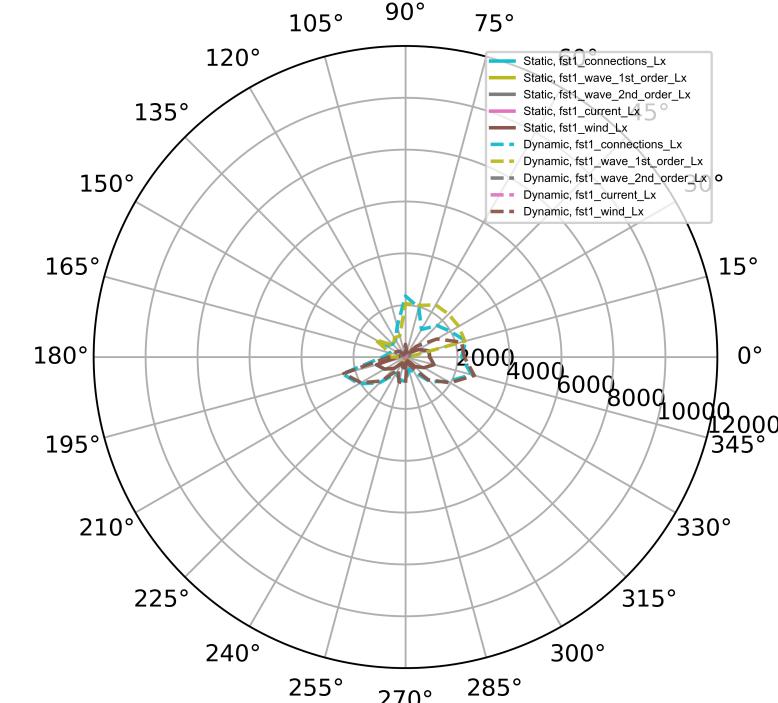
FST2

FSTs 95% LNG, LWL, FST2, Loads, Lx direction



FST1

FSTs 95% LNG, LWL, FST1, Loads, Lx direction



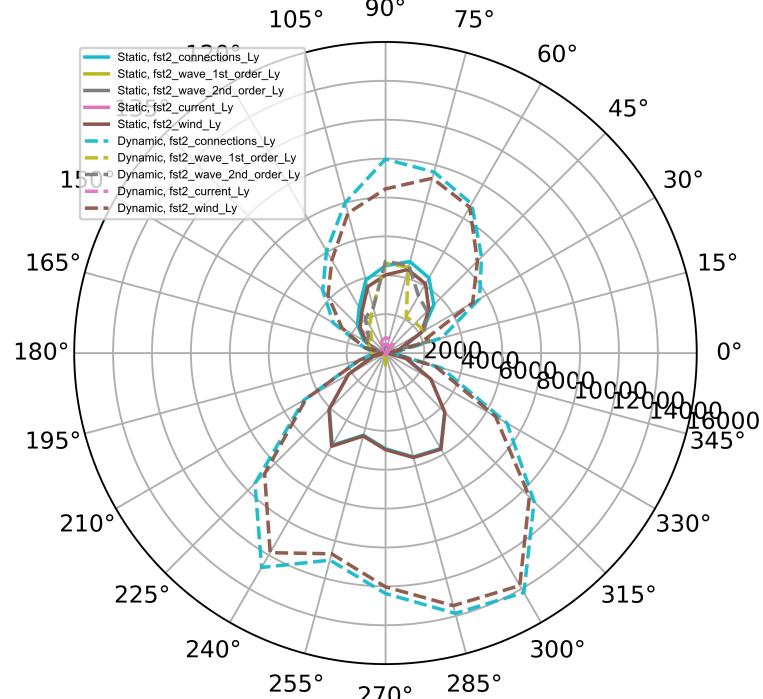
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# FSTs 15% LNG, 100yr, LWL, FST Forces, Y Direction

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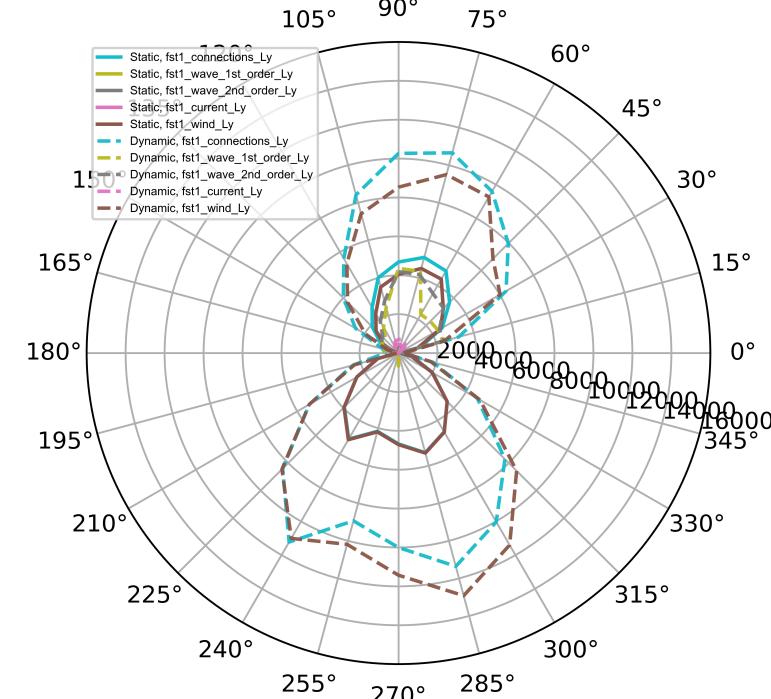
FST2

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



FST1

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



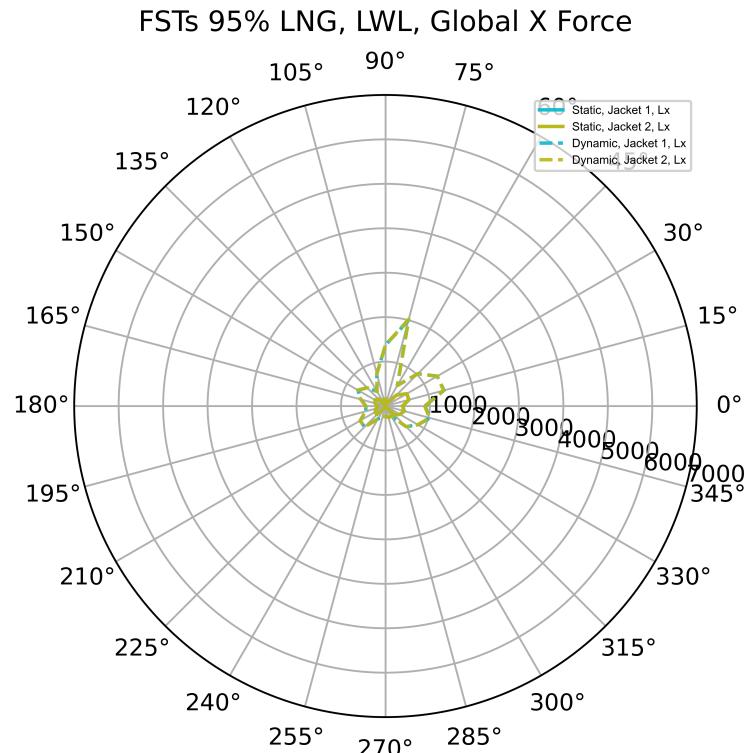
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## **Jacket Loads**

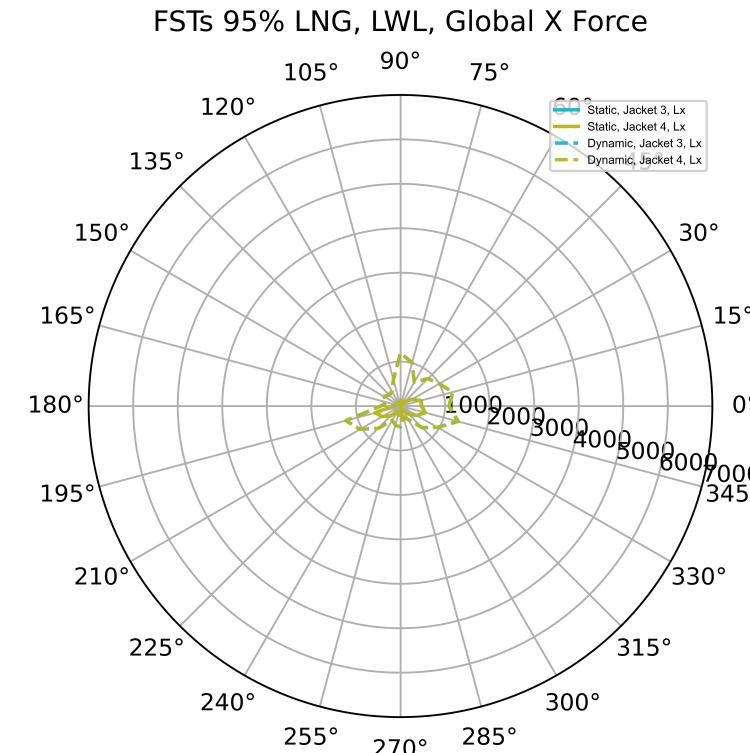
# Max Jacket Loads, FSTs 95% LNG, 100yr, LWL, Fx

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

FST2



FST1

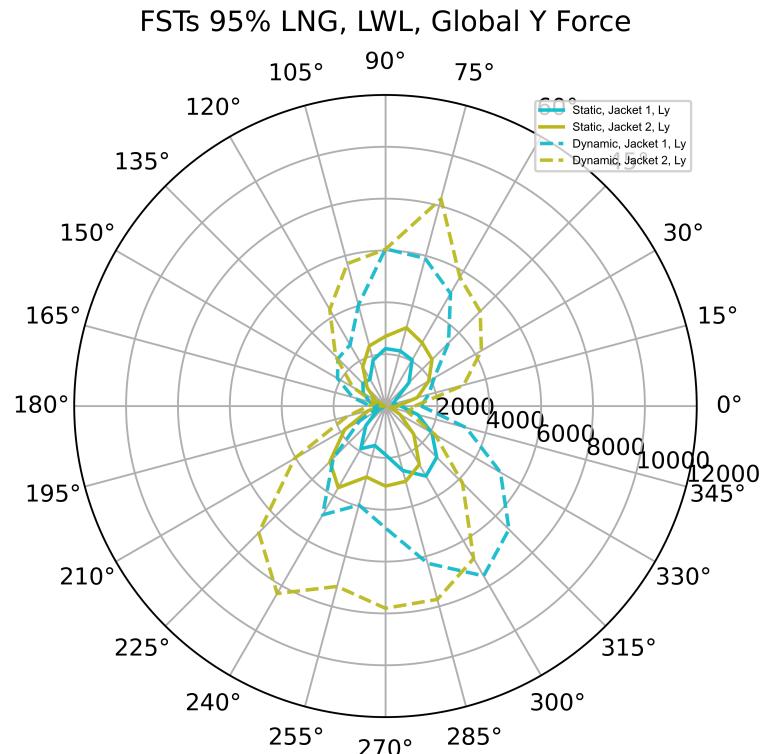


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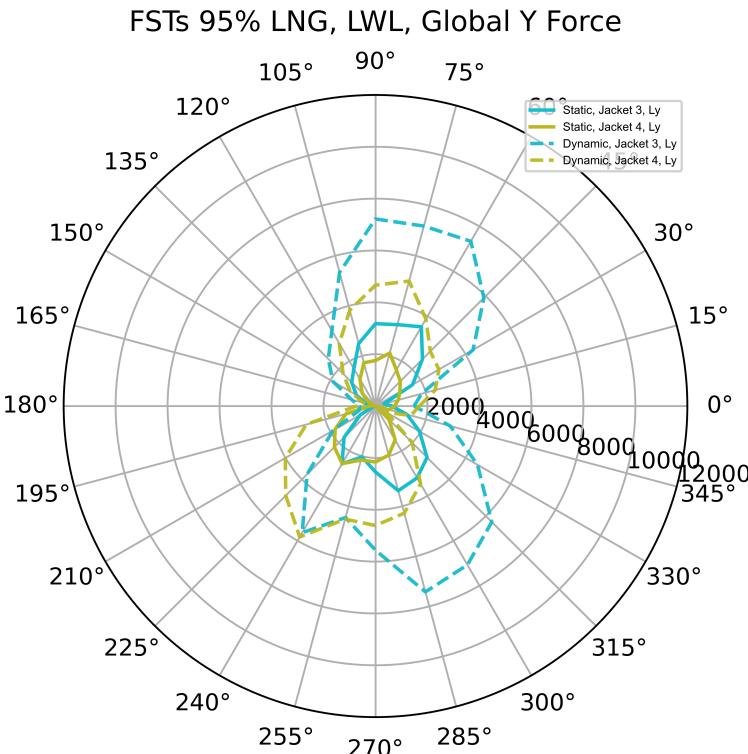
# Max Jacket Loads, FSTs 95% LNG, 100yr, LWL, Fy

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

FST2



FST1

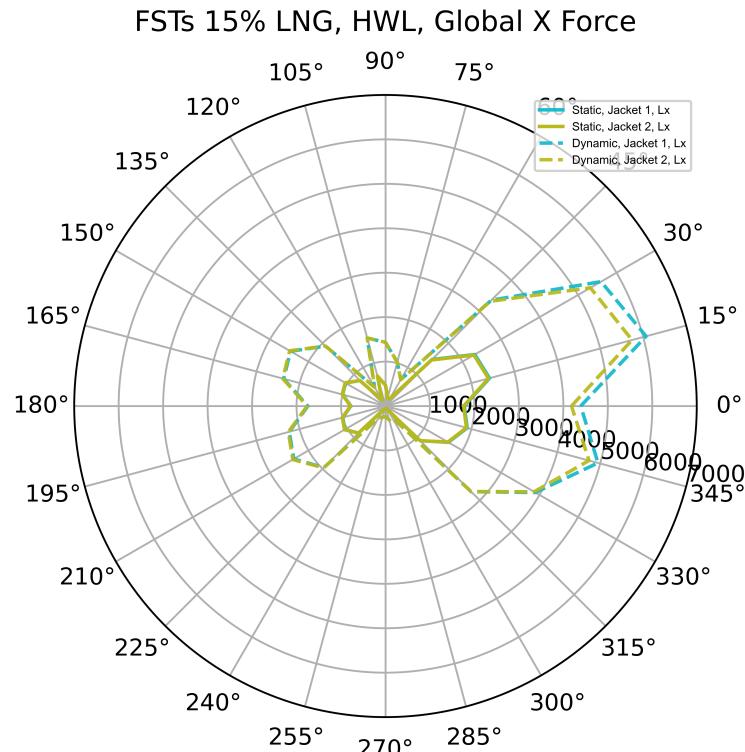


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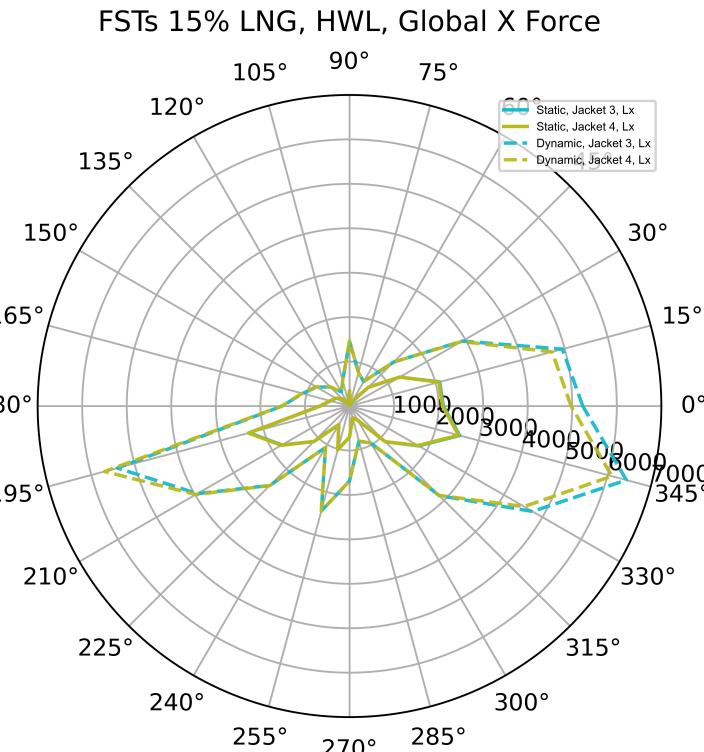
# Max Jacket Loads, FSTs 95% LNG, 100yr, HWL, Fx

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

FST2



FST1

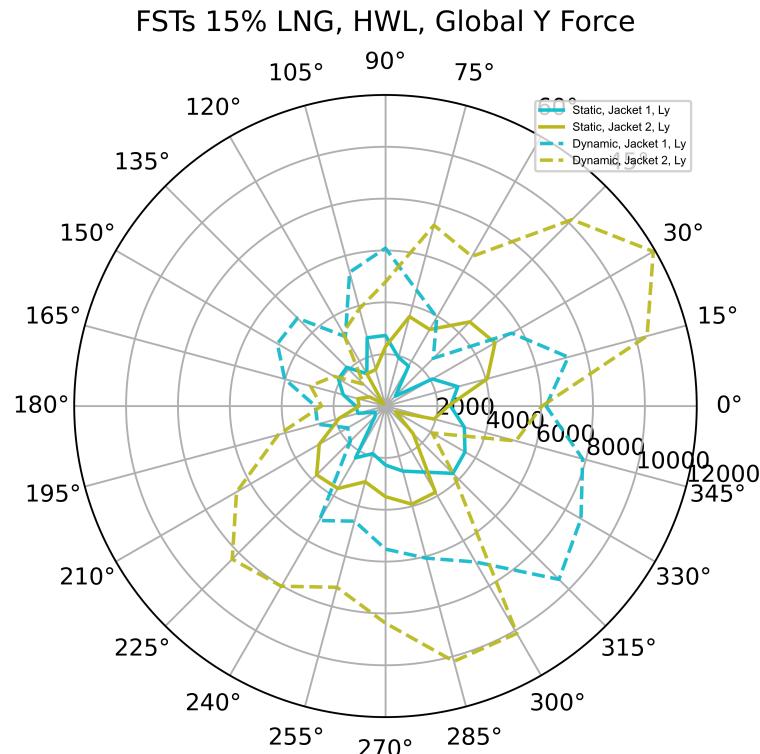


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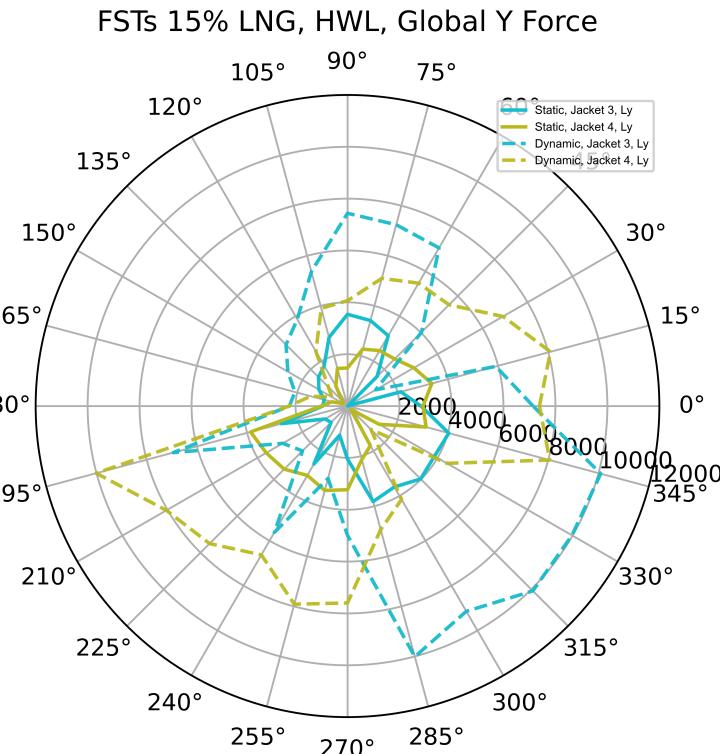
# Max Jacket Loads, FSTs 95% LNG, 100yr, HWL, Fy

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

FST2



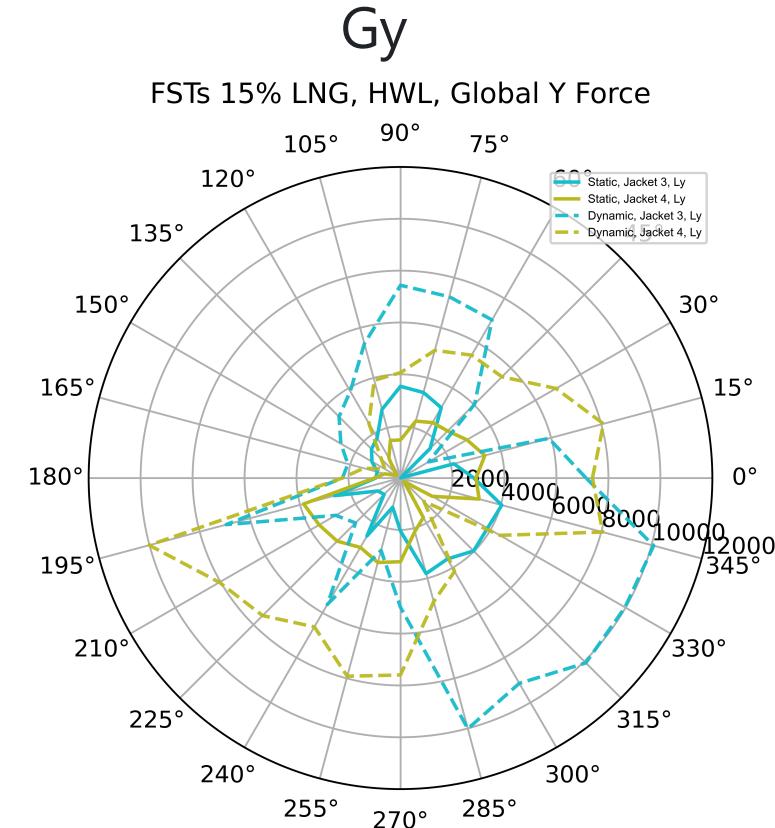
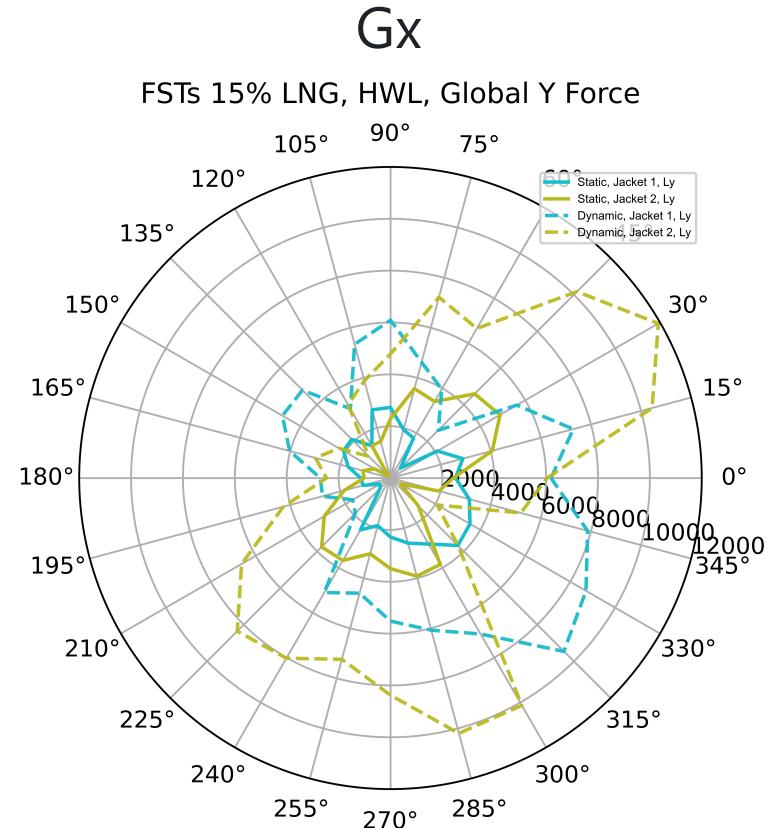
FST1



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# Max Jacket Loads, FSTs 95% LNG, 100yr, HWL, Fx vs. Fy

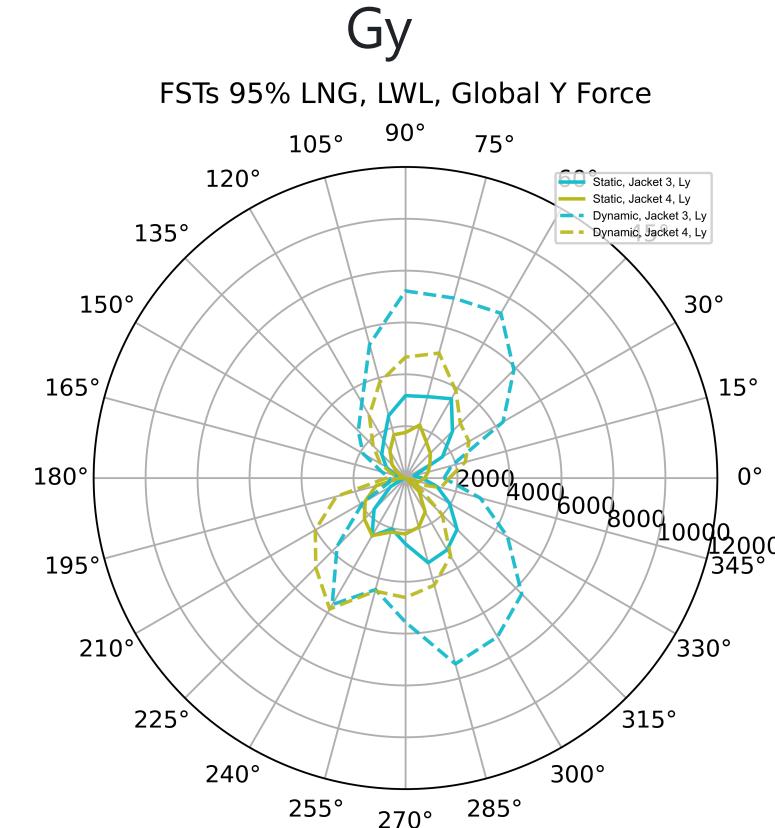
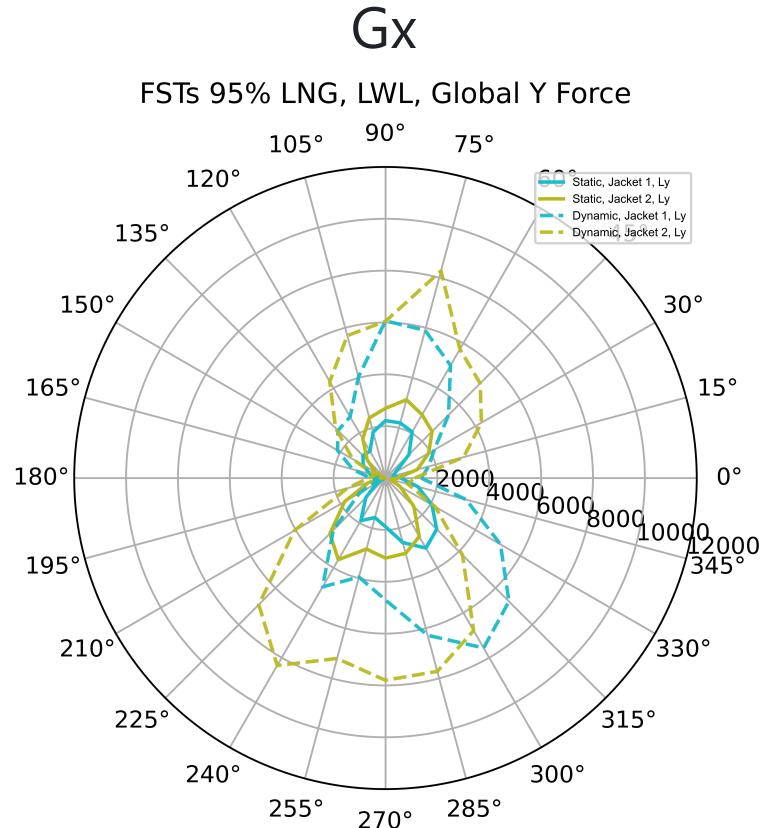
- Two (2) struts contribute to each jacket global force



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# Max Jacket Loads, FSTs 95% LNG, 100yr, LWL, Fx vs. Fy

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



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# Max Jacket Loads, FSTs 15% LNG, 100yr, HWL, Fx vs. Fy

- Max loads are absolute maximum i.e. max (abs(max), abs(min))



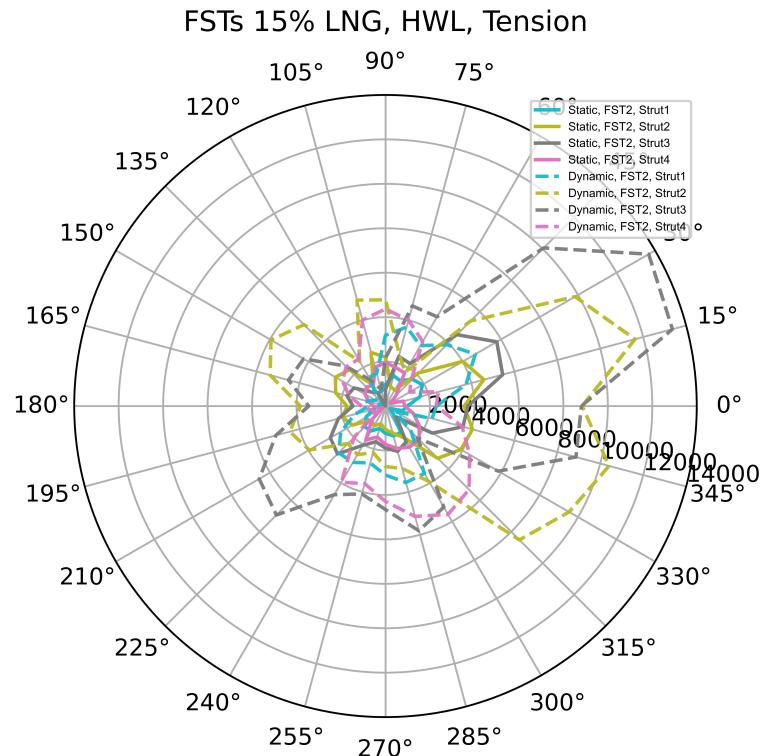
- The HWL static & dynamic forces are significantly higher than those of LWL.
- The 15% LNG & LWL needs to be investigated further.

# **Strut Loads**

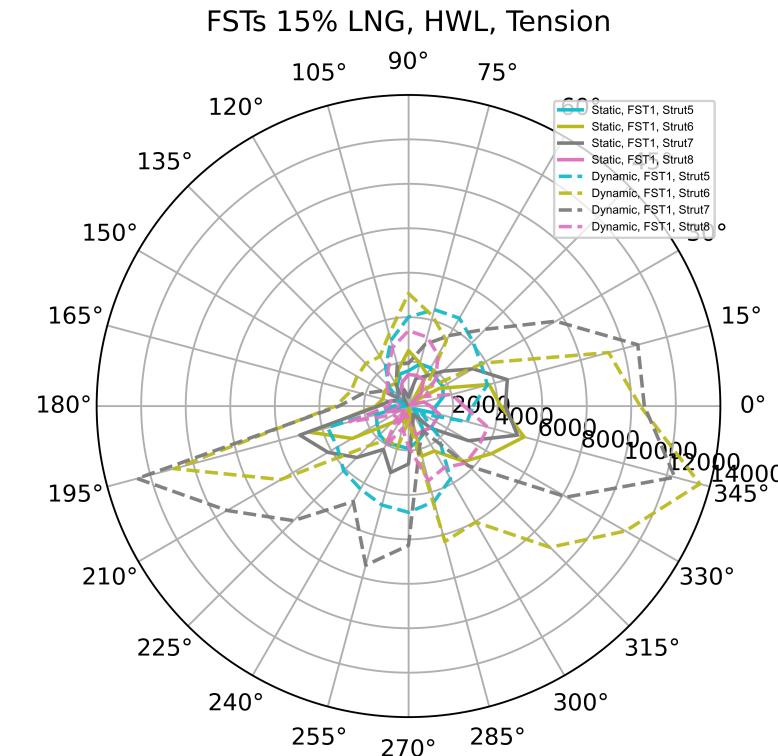
# Max Strut Loads, FSTs 95% LNG, 100yr, HWL, Tension

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FST2



FST1

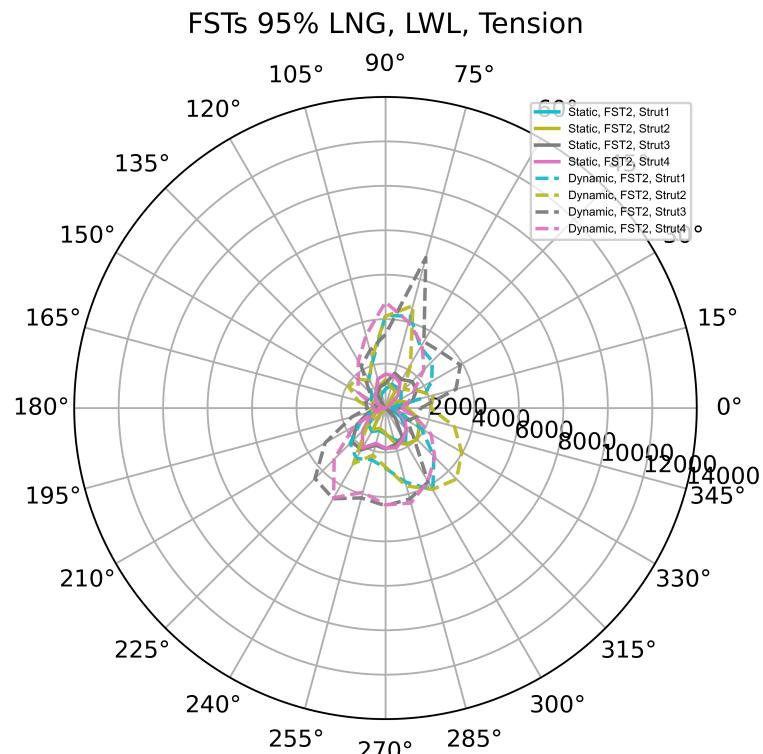


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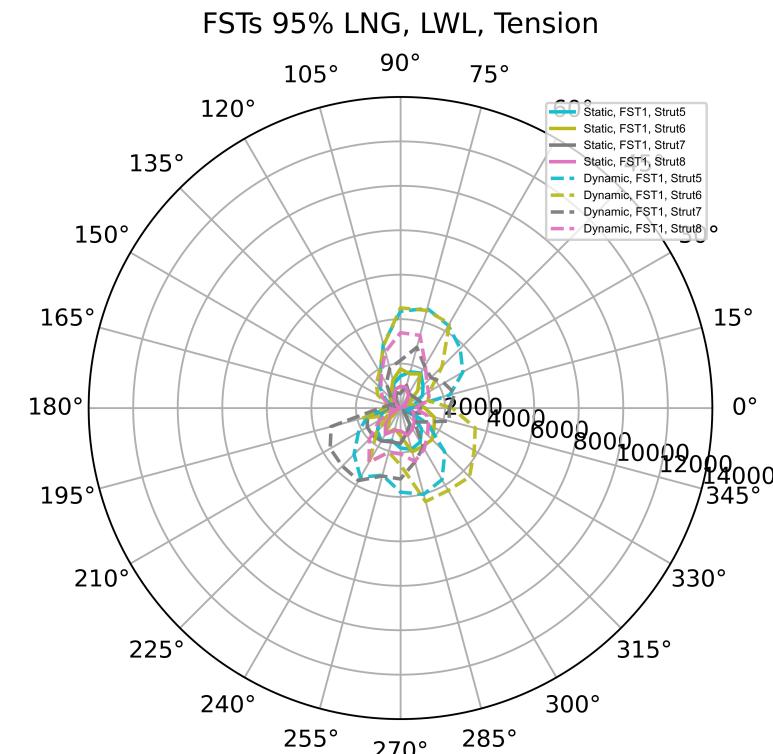
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- TBA

FST2



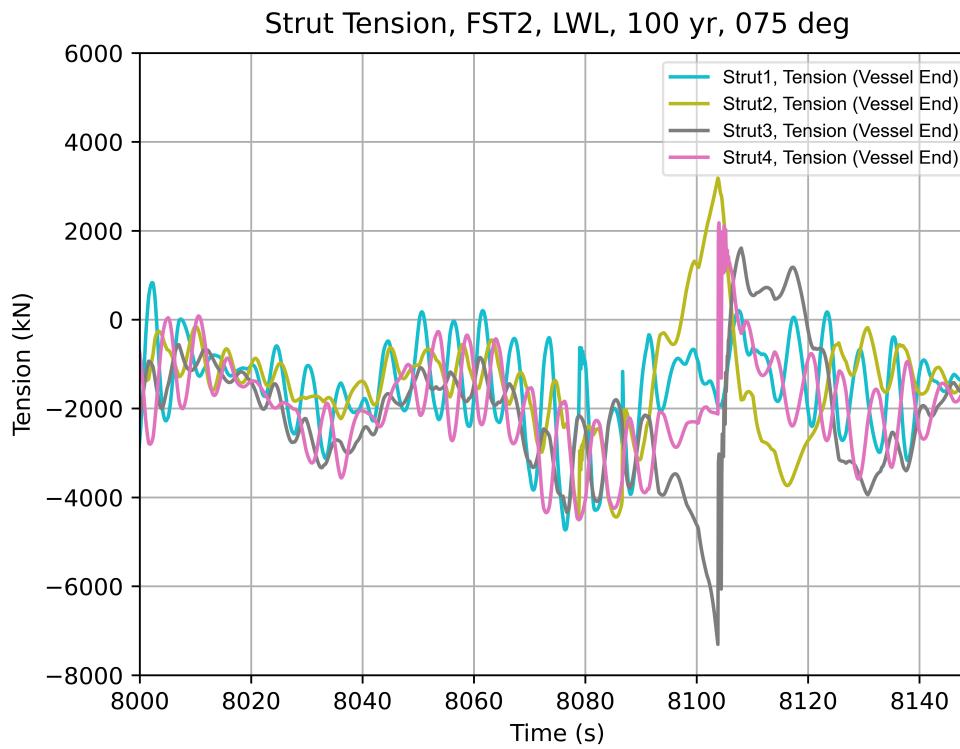
FST1



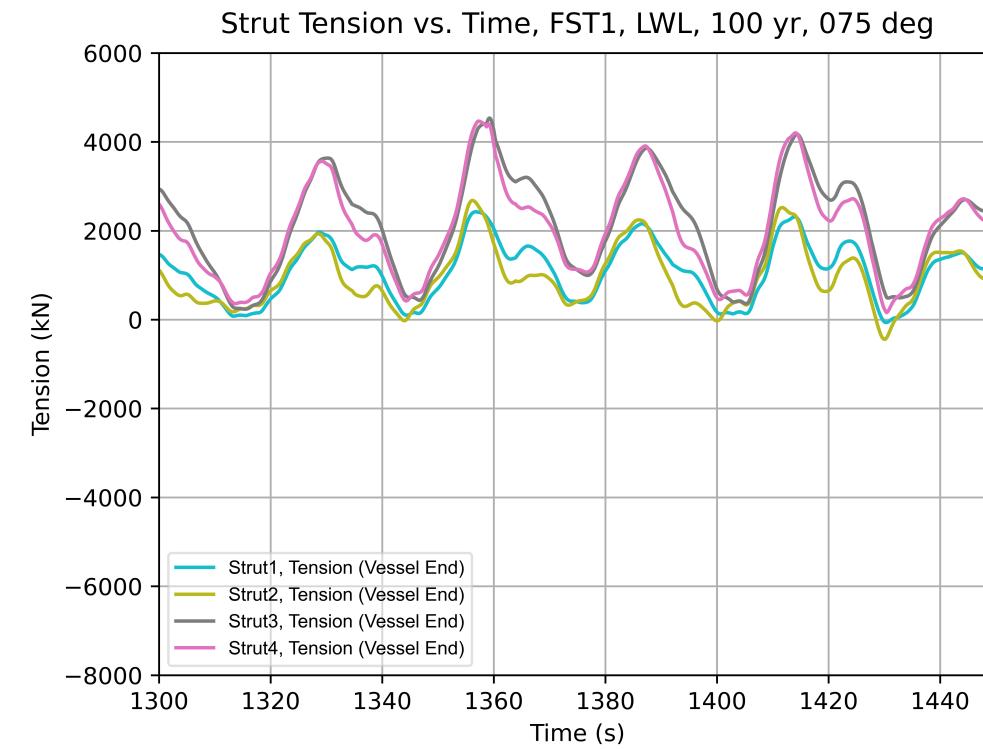
- TBA

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

Min -ve



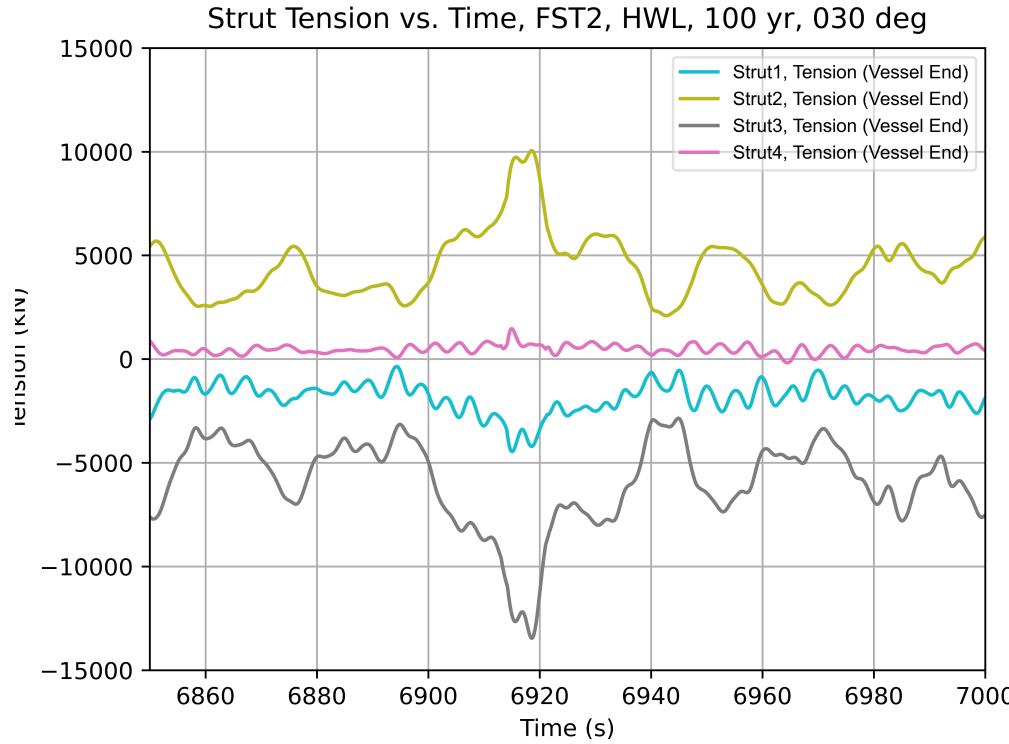
Max +ve



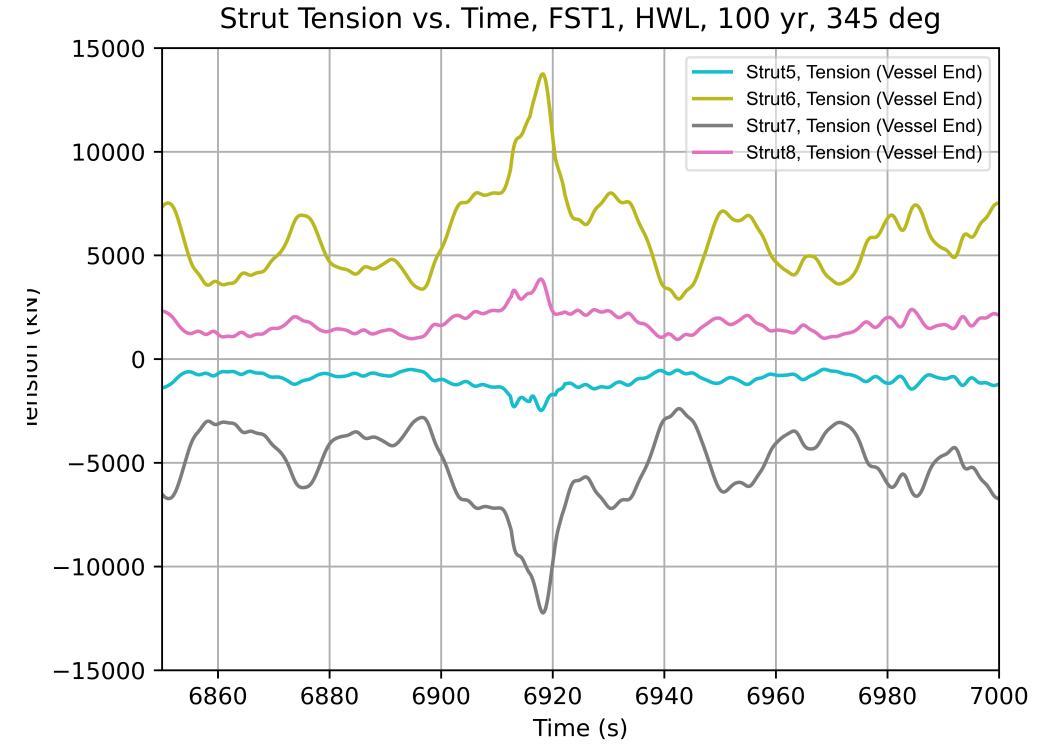
- The struts are in sync
- Results in lower strut forces when compared to HWL results

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

Min -ve



Max +ve



- The 2 struts 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