Installation of Jasmund jacket - theory and practice

Introduction presenters

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Msc Marine Technology – working on ship hydrodynamics and stability as well as operational support

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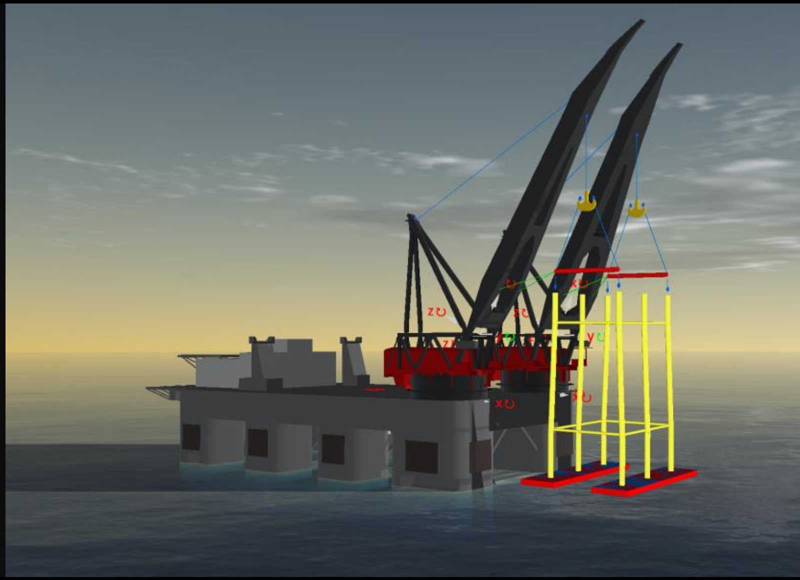
Analysis engineer, Entail

MSc Marine Hydrodynamics – working with marine operation analysis and software development

Agenda

- Project introduction
- Unique challenge
- How to solve the challenge
- Operational insights



Project introduction: Jasmund OSS

- Project:
  - Substation capacity: 300MW
  - Components: 4400mT jacket
5300mT topside
  - Location: Baltic Sea

- Installation vessel Thialf
  - Lift capacity: 14,200mT
  - Length: 202m
  - Width: 88.4m

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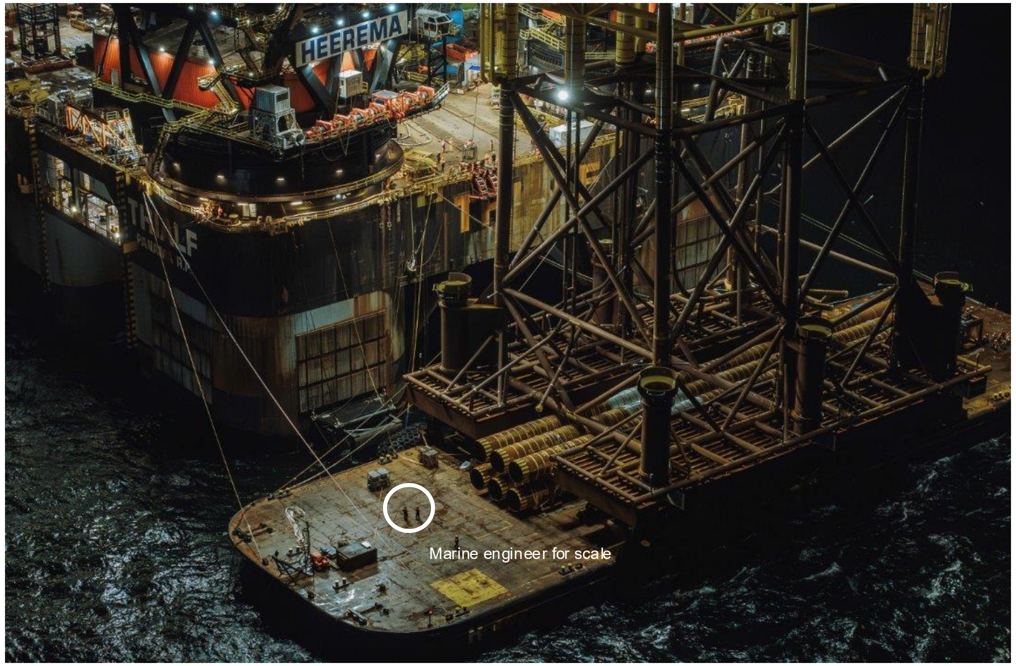
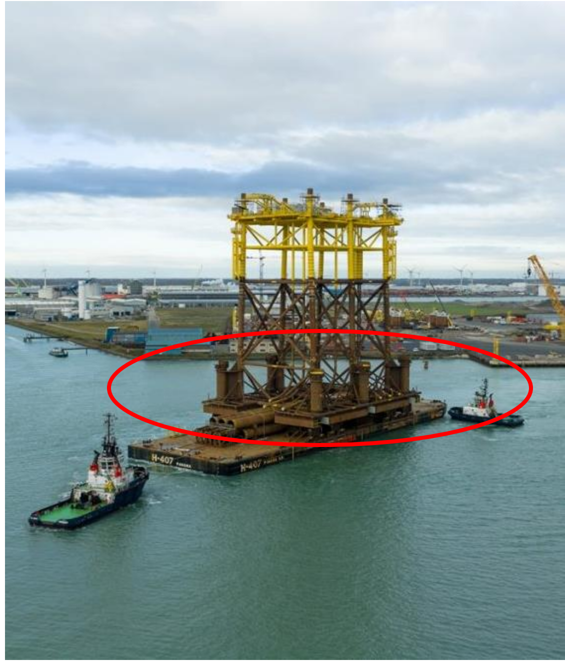
Typical marine scope jacket installation as installation contractor

- Transport
  - Stability
  - Accelerations
  - Barge strength
  - Bollard pull
- Mooring and Lift analysis
  - System dynamics
  - Operational limits
- Offshore Decision Support
  - Winter campaign





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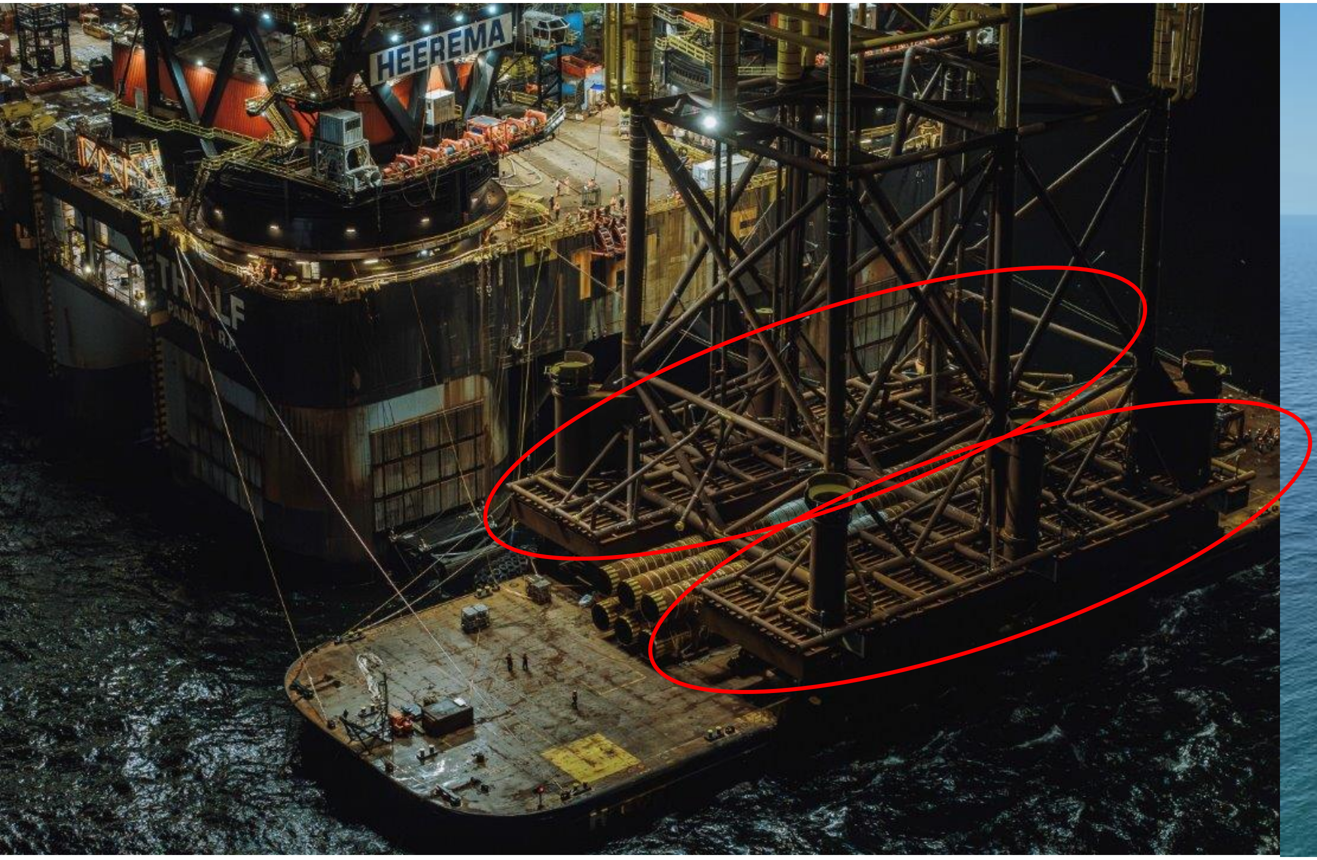
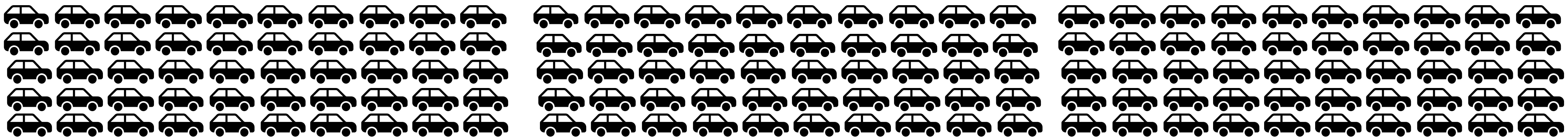
Unique challenges



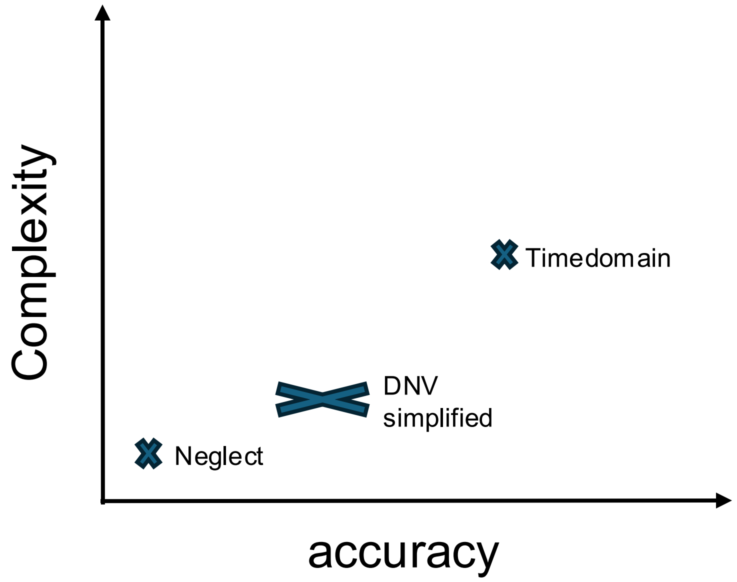
Unique challenges

- Large mudmats can cause large dynamics (or even snap loads) in rigging



- How should we deal with large slamming areas while lowering through the waterline
  - Neglect effects?
  - DNV-RP-N103: Lifting through the waterline?
  - Different options?

- DNV:
  - Lowering velocity + Cranetip dynamics + orbital wave velocity = total impact velocity
  - Slamming area = total slamming surface (projected area to the wave)
  - DNV: *"The horizontal extend of the lifted object is relatively small compared to the wave length"*
  - Result:
    - Zero workability
    - Hs < 0.5m

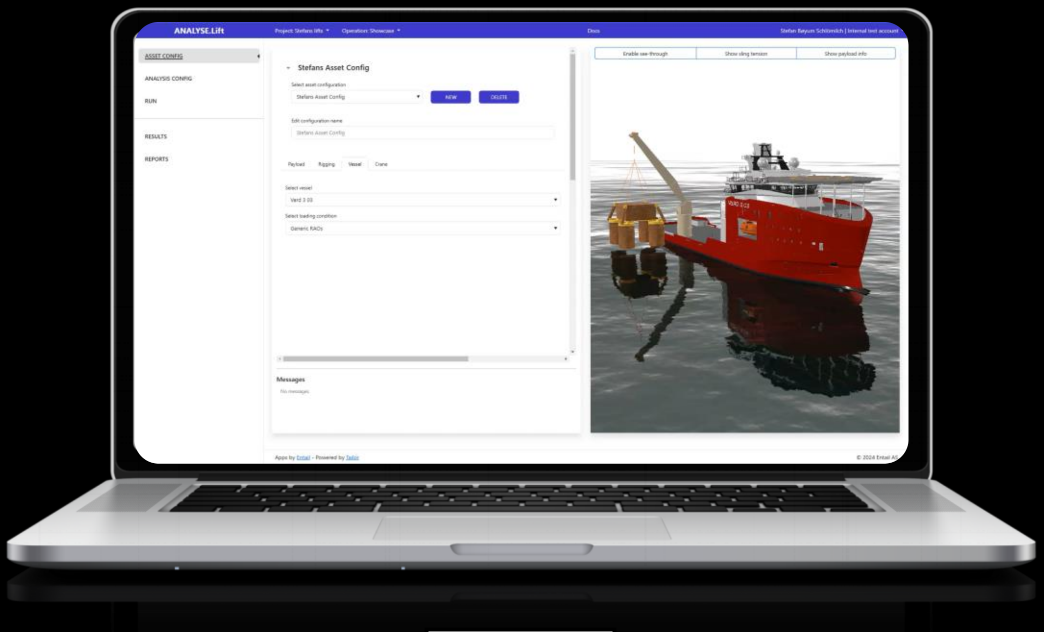


ANALYSE.Lift

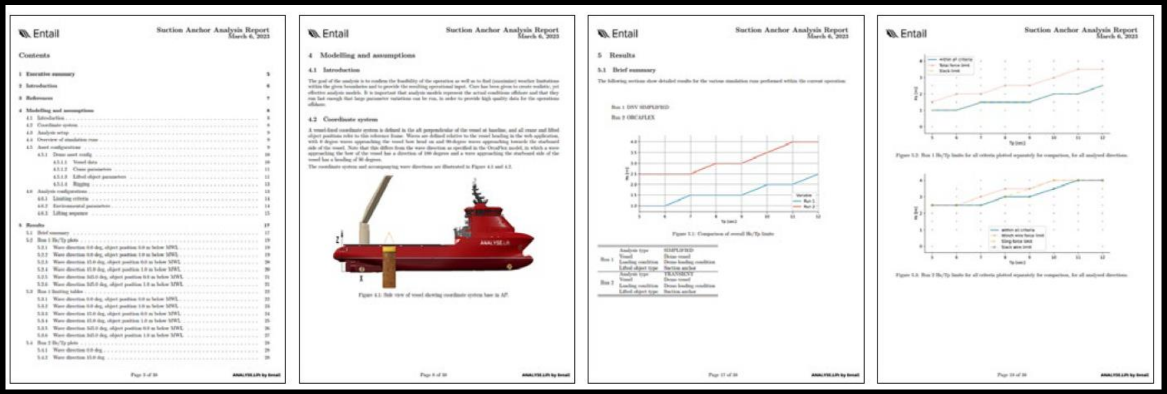
Quick iterations through efficient engineering

- Built on 10 years of automation experience in 100s of projects

- Completely integrated workflow
- All these manual tasks have been automated:
  - Model building
  - Assigning hydrodynamic parameters
  - Creation of batch files
  - All file handling
  - Running of files
  - Post processing
  - Report writing



30 min



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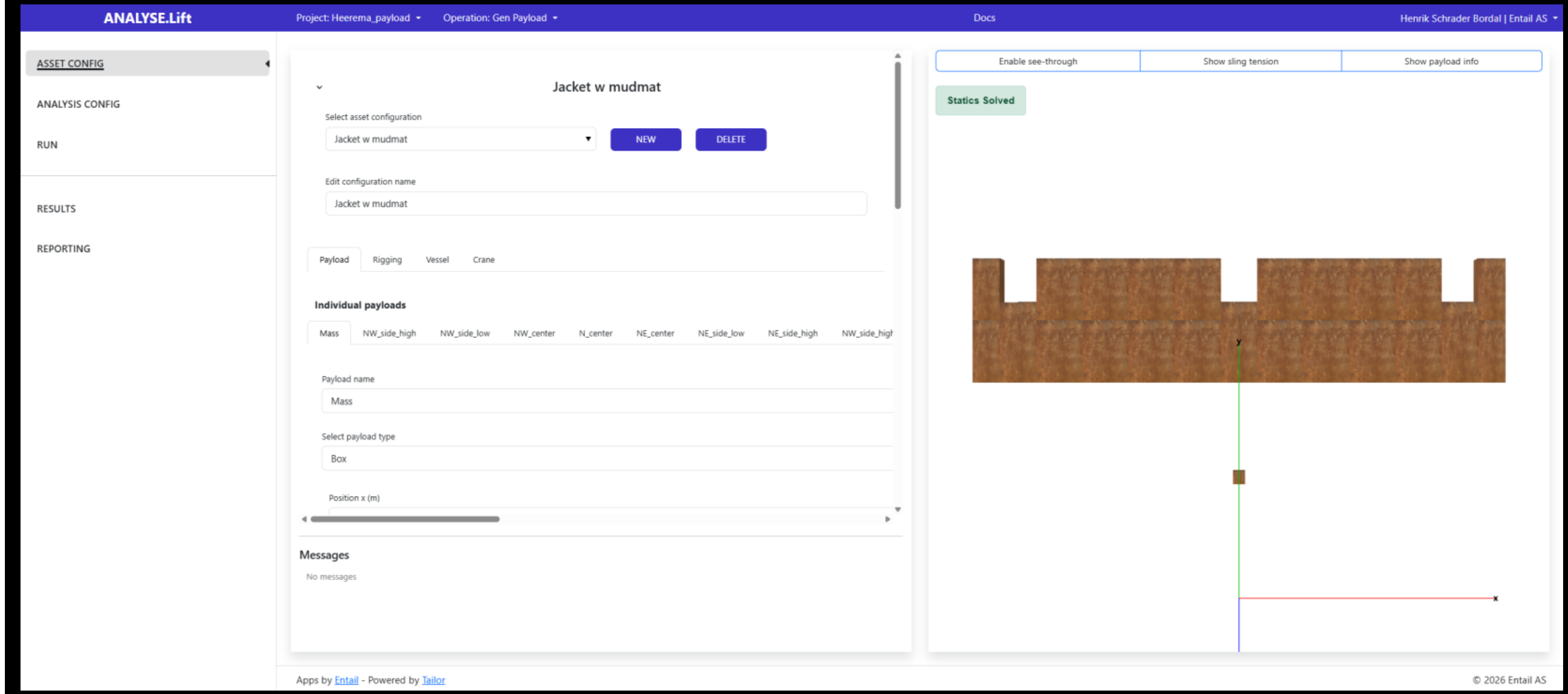
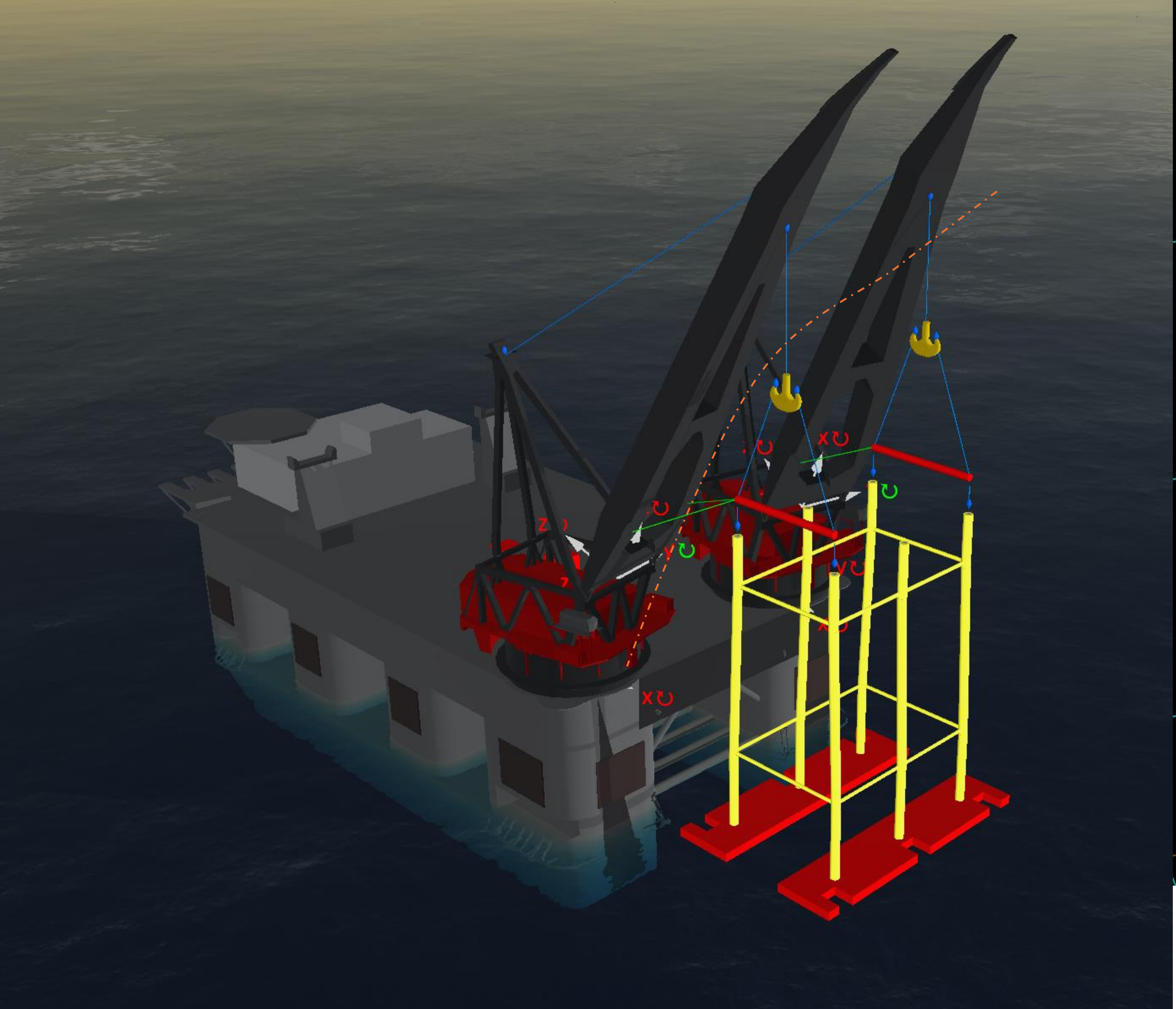
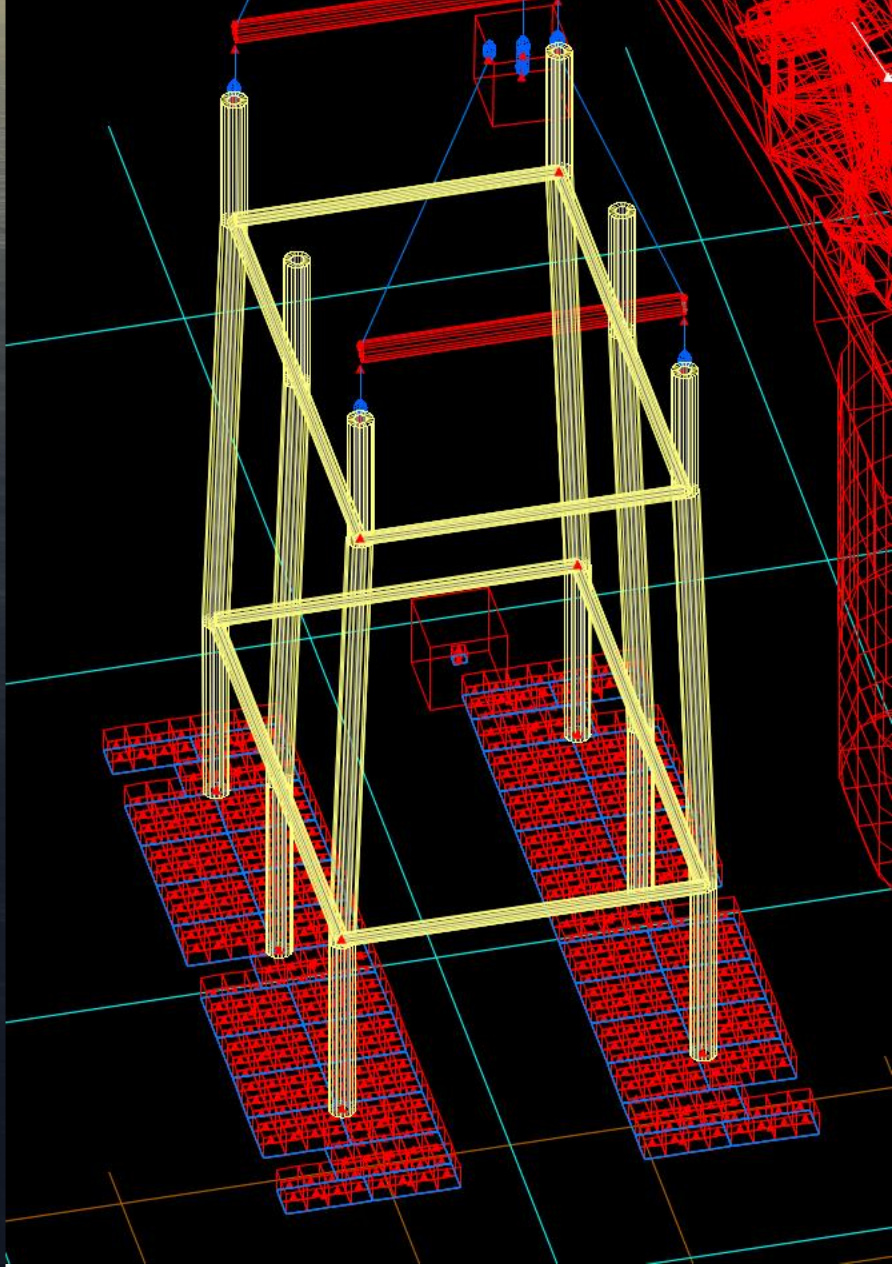
- Used Entails software ANALYSE.Lift to model mudmats and jacket mass properties
- Automatically models as OrcaFlex 6D Buoys -> using Morisons equation for hydrodynamic loads
- Allowed us to do ~30 iterations with 21000 analyses per iteration







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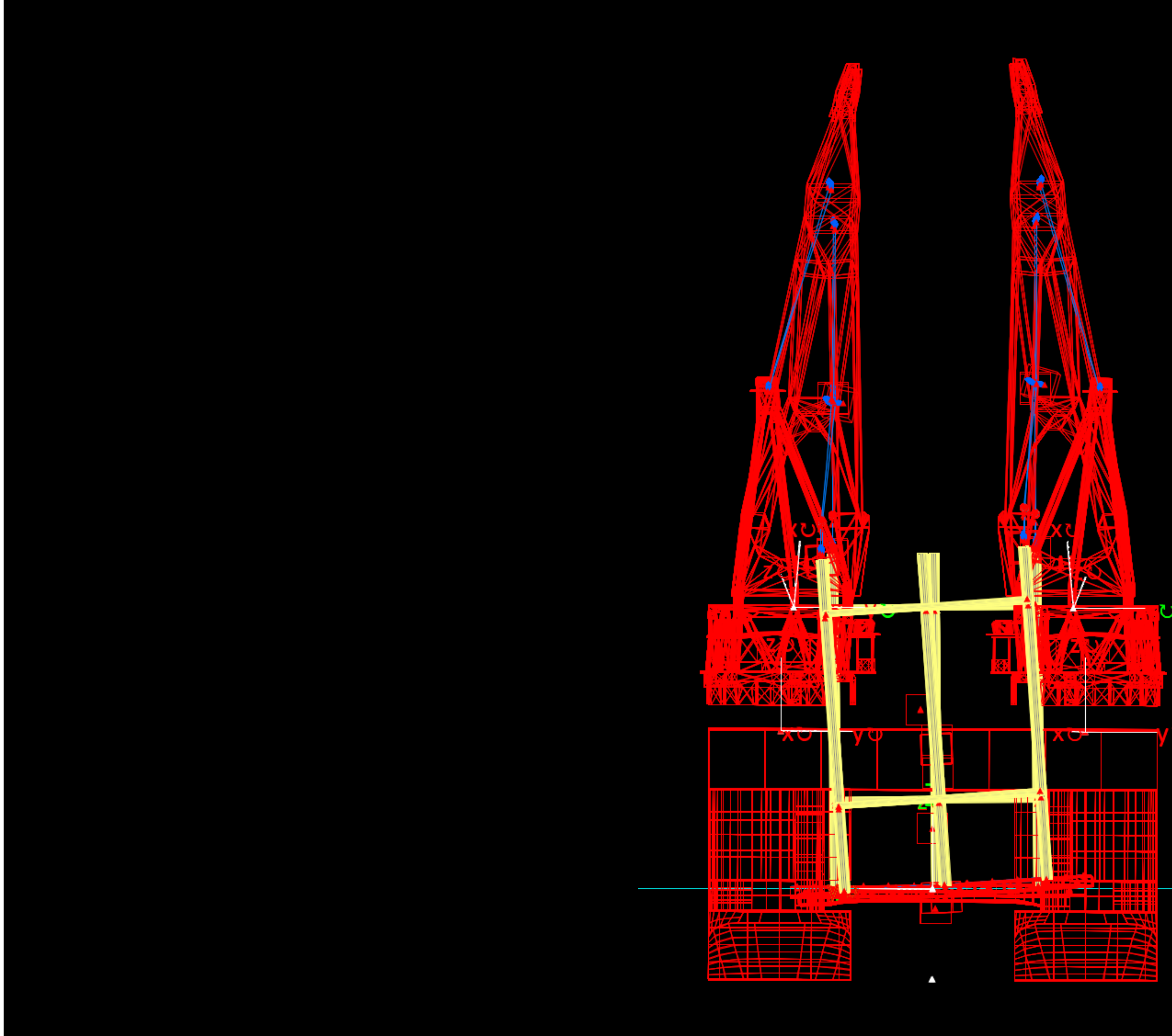
Eigenmode analysis

- Two crucial eigenmodes identified
  - Jacket roll (~7s)
  - Jacket pitch (~3s)



Analysis

- Strict weather criteria -> need to refine model
- Alternatives
  - Transient analysis
  - Tilted lift
  - Tugger lines
  - Include shielding effects (free heading)
  - Wave spreading
  - Diffraction analysis

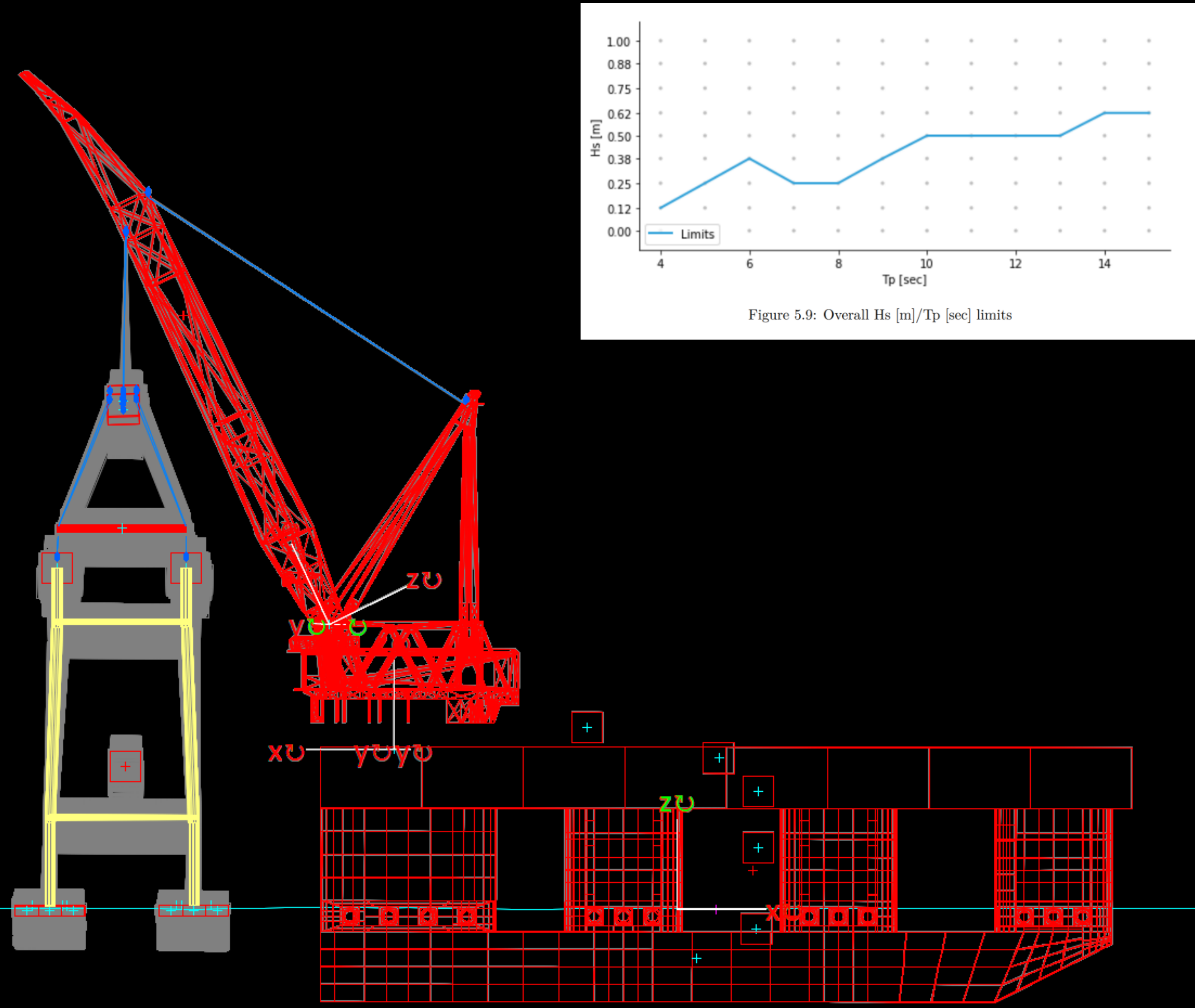


Figure 5.9: Overall Hs [m]/Tp [sec] limits

Analysis

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- Alternatives
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  - **Tilted lift**
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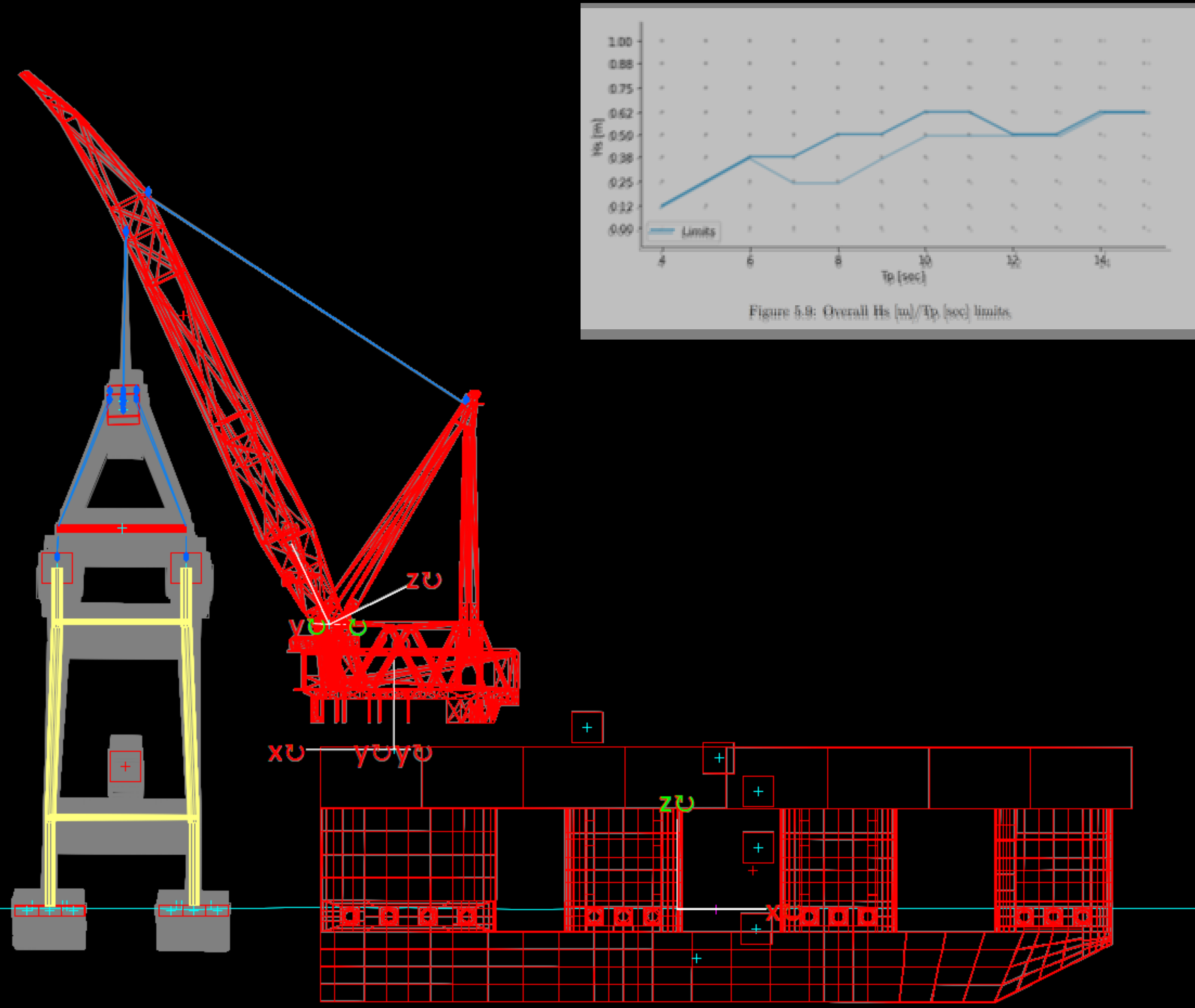

Figure 5.9: Overall Hs [m]/Tp [sec] limits

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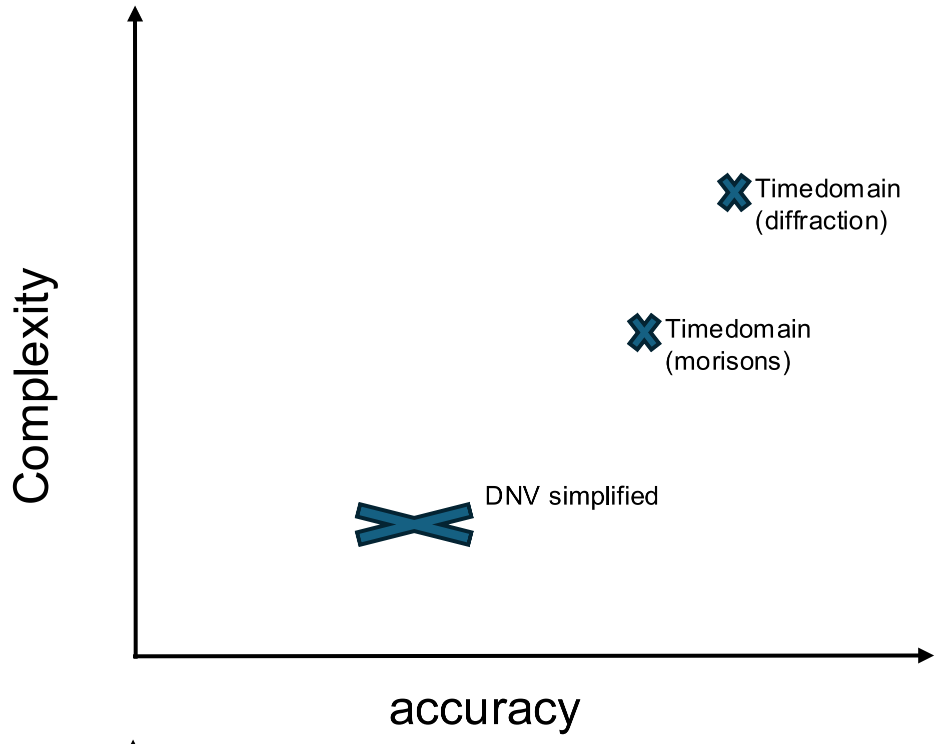
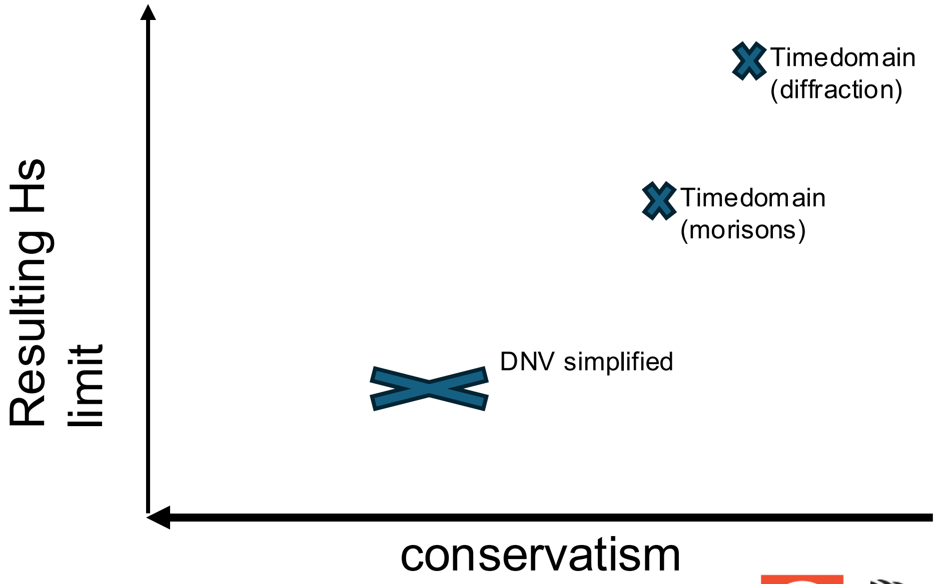
Comparison of methodologies

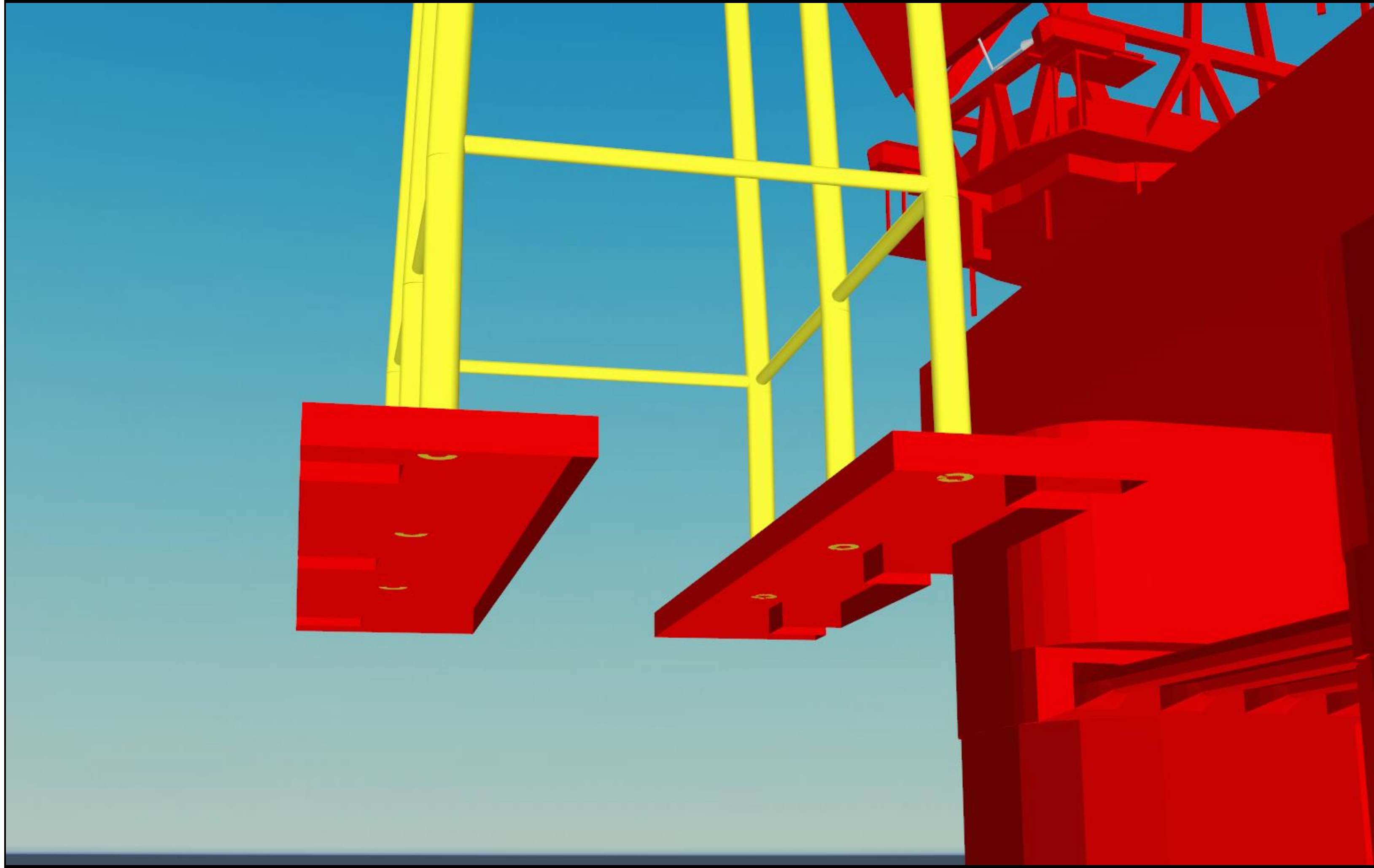
- Morisons
    - Assumes small objects
    - Object does not disturb the wave
- Diffraction
    - Object disturbs wave
    - Includes effect of ‘altered wave’ and radiation due to object motion





Diffraction analysis

- Modelling mudmats and creating mesh
- OrcaWave diffraction analysis at several waterdepths
  - Balancing mesh size, submergence and computational cost
- Vessel object represents the frequency-dependent added mass, damping and excitation forces
- 6D buoys represent drag and slam forces



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Diffraction analysis

- Modellin
creating
- OrcaWav
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    - Balar
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- Vessel o
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- 6D buoys represent drag and slam forces

✅ Final-Final Nuclear-Plus Option:

We must:

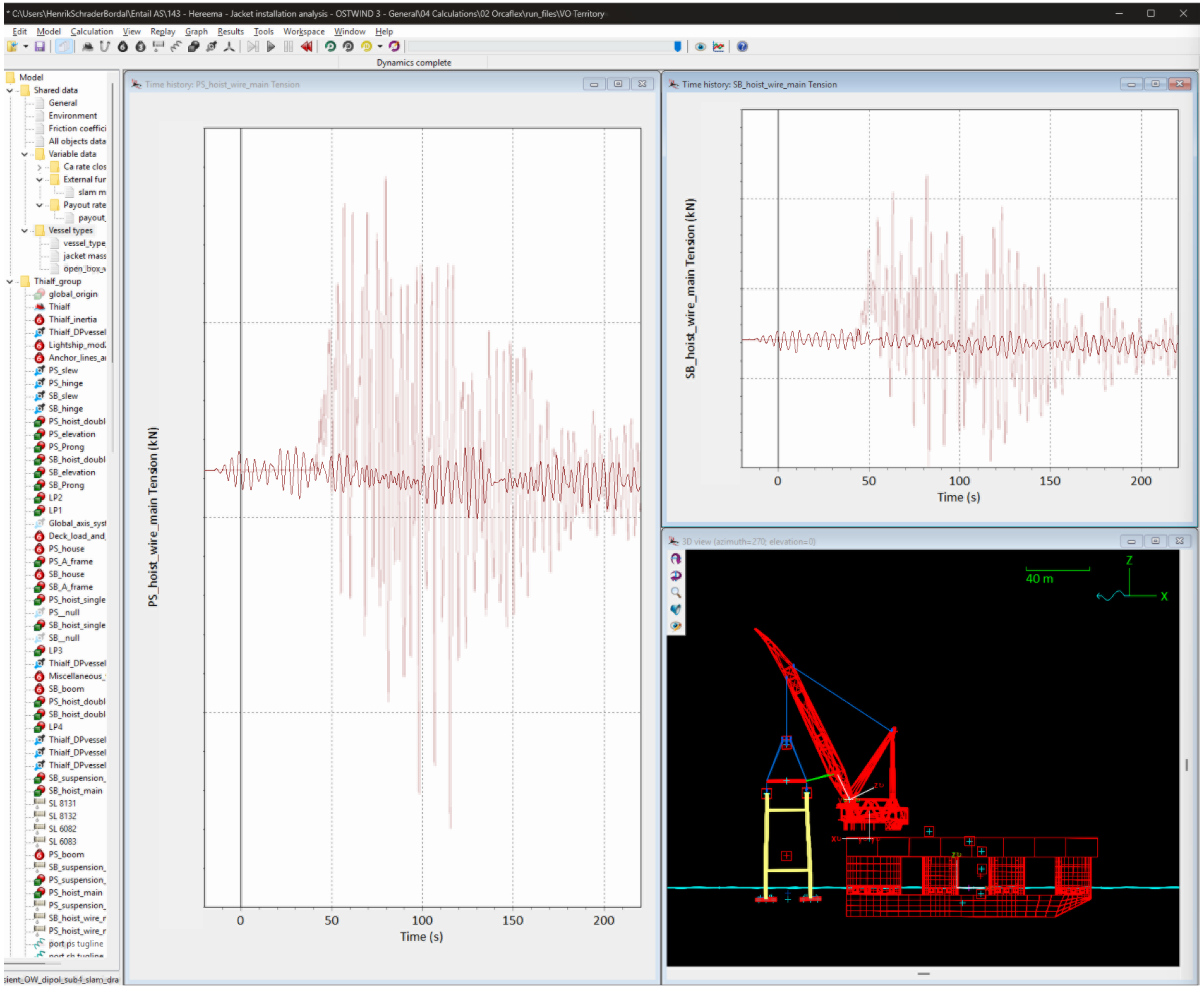
1. Rebuild the mesh **from scratch**
2. Identify the exact **shared vertex** above
3. Create a **bridging triangle** or **reindex faces** to force both shells to use the same vertex instance

Would you like me to:

- 🔧 Rebuild the mesh right now using shared face indexing across that point?
- 📍 Just output a list of all shared coordinates between the shells so you can stitch them in Rhino?
- 😅 Call it a day and start drinking?

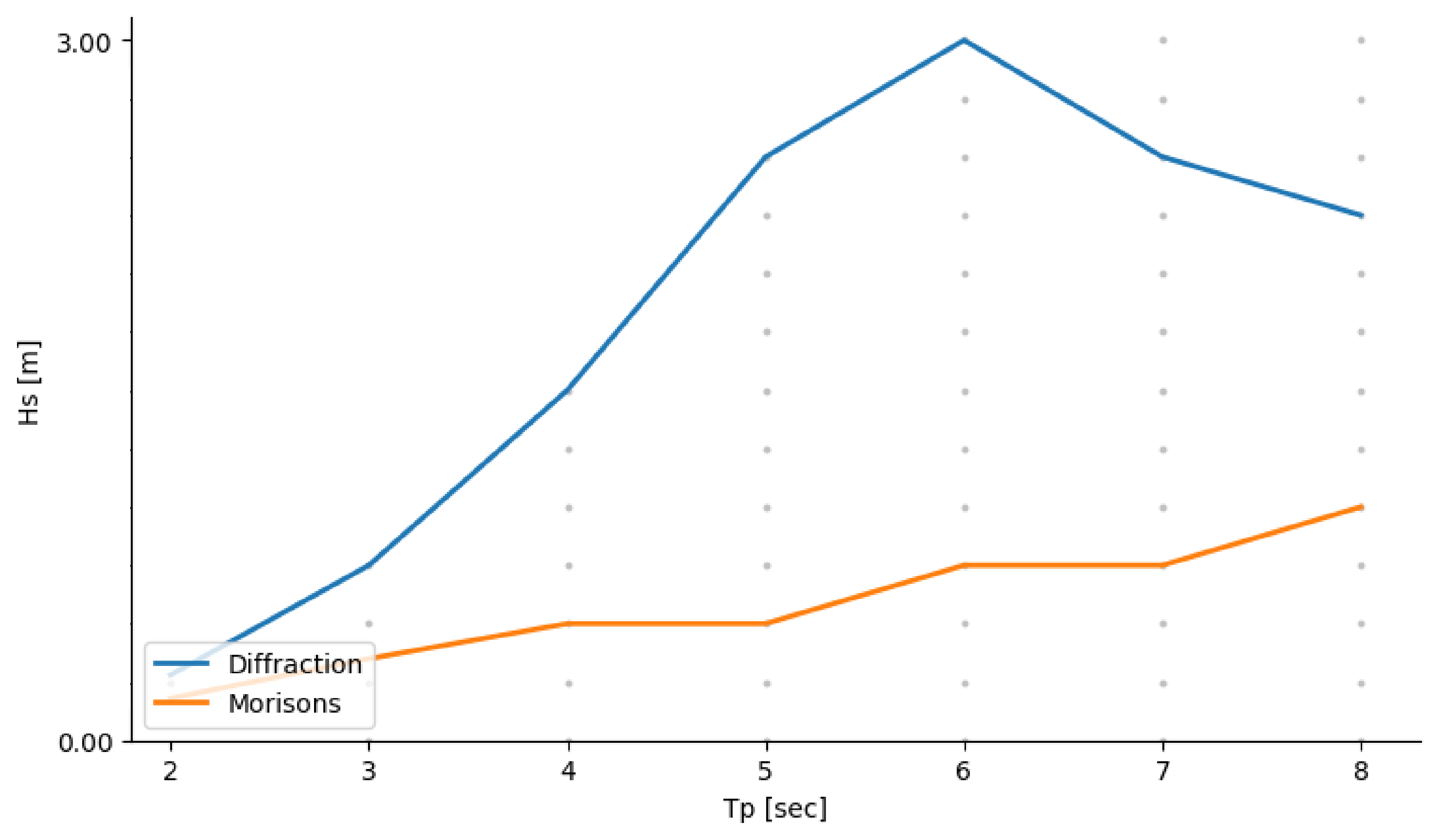
Your call, commander.

Comparison of time series:

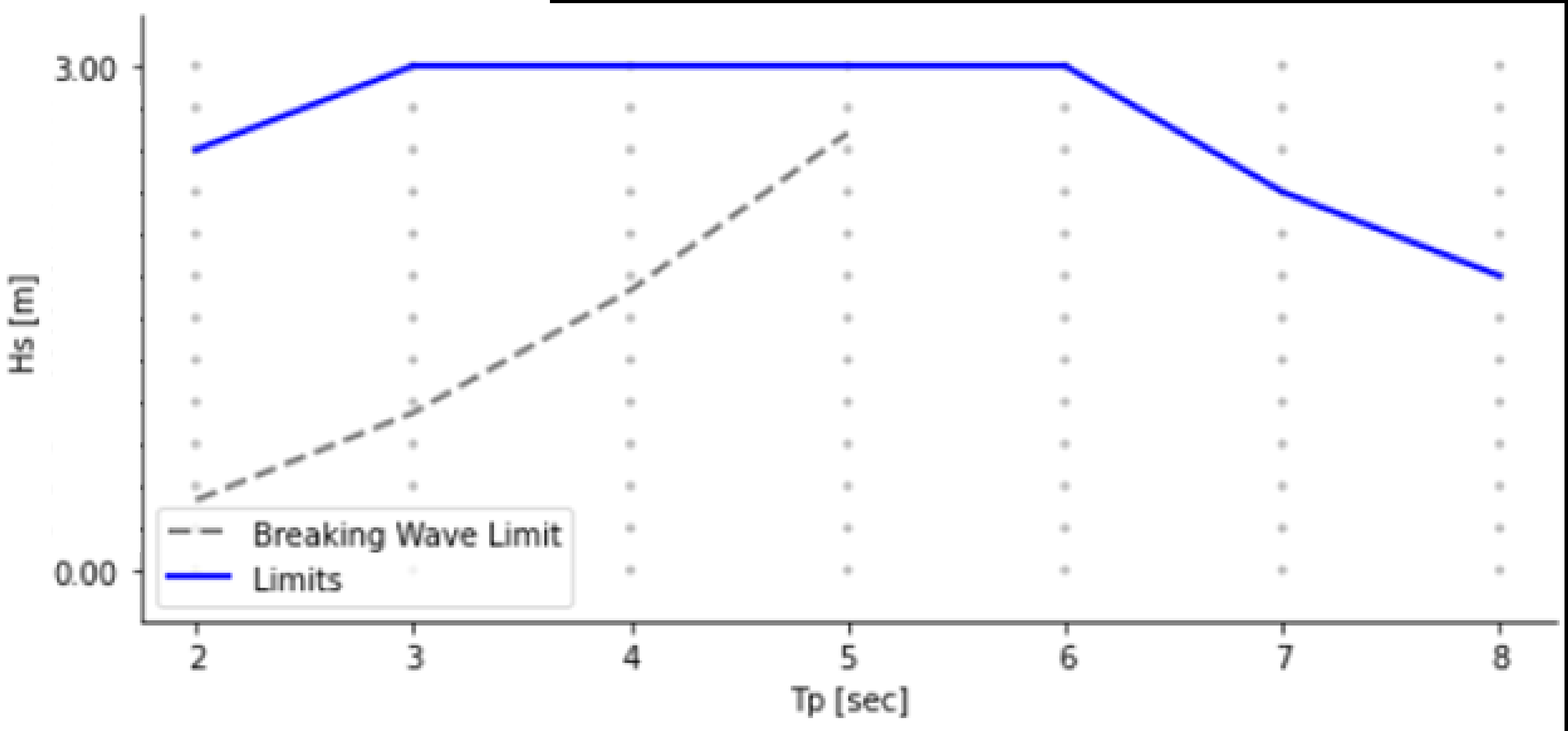


Results

- Omnidirectional results presented to the right
- Analysis limited upwards by wave steepness criterion given in DNV



Results



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Model validation and learning from offshore

How to 'validate' a model

- Gaining insight by:
  - Vessel sensor data: Hoist wire loads
  - Tarka box motion sensors
  - Wave rider buoy

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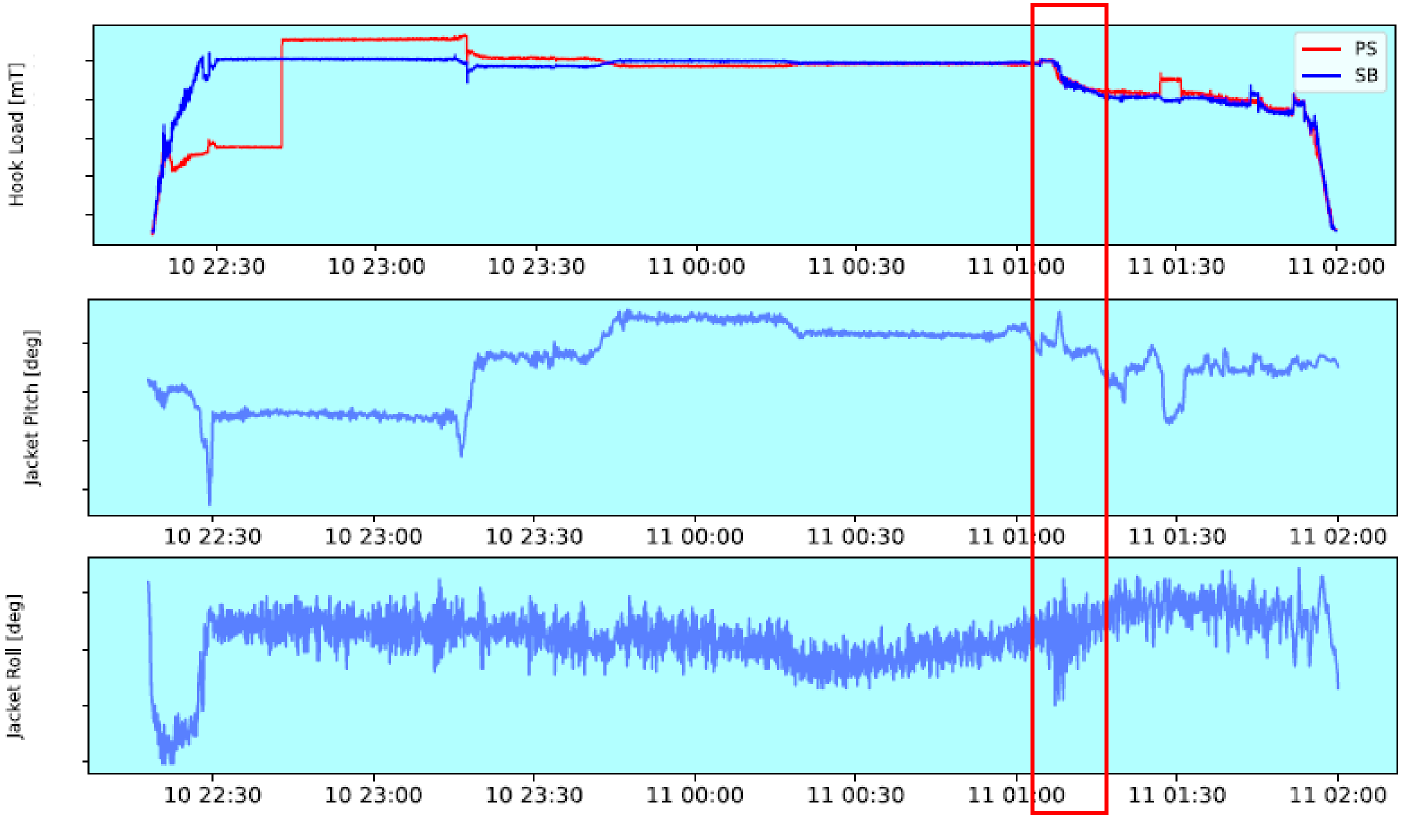
Timetraces total installation

- Benign conditions (Hs~1.0-1.5 m, Tp~5s)
- Very small increase in DAF
- Small peak in jacket pitch
- Significant increase in jacket roll



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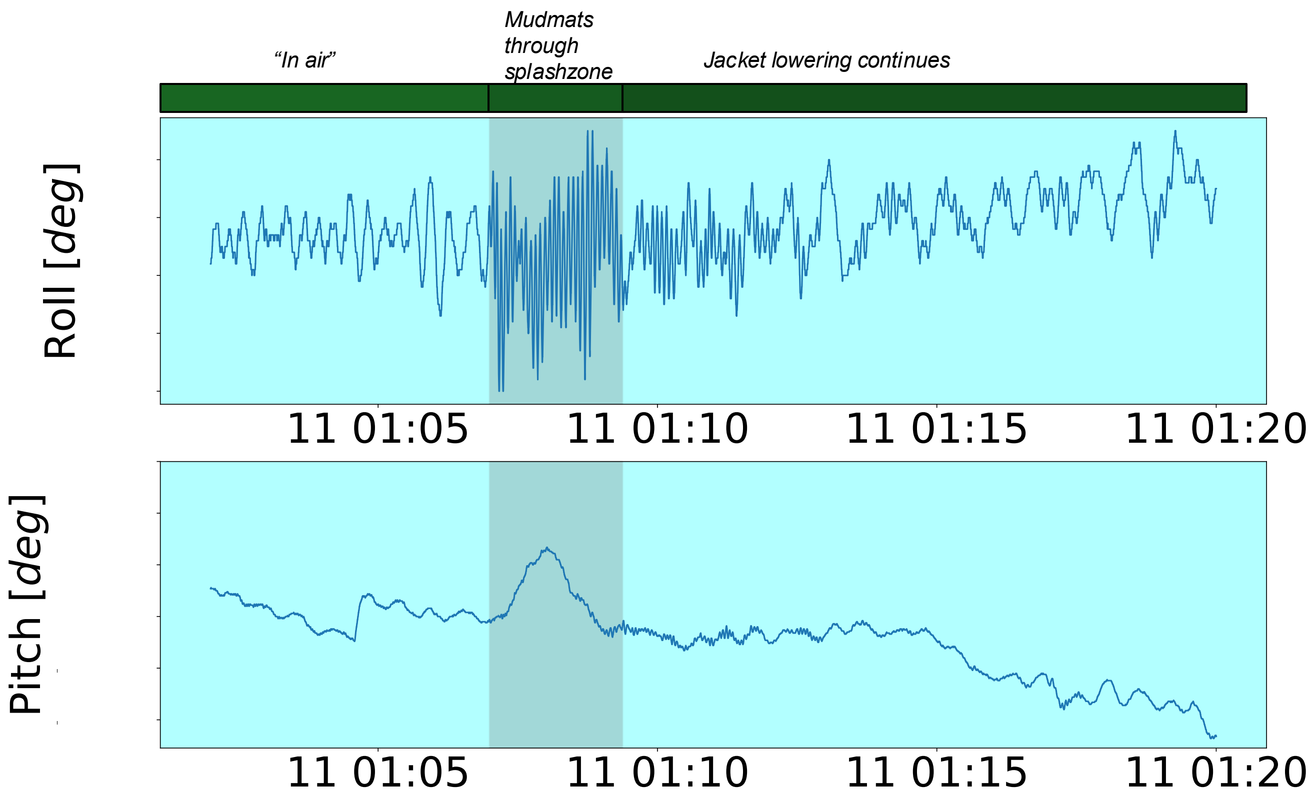
Splashzone Tarka data

- Jacket roll increased in splashzone
- Trim was increased to lower slamming loads
- Different period compared to other stages



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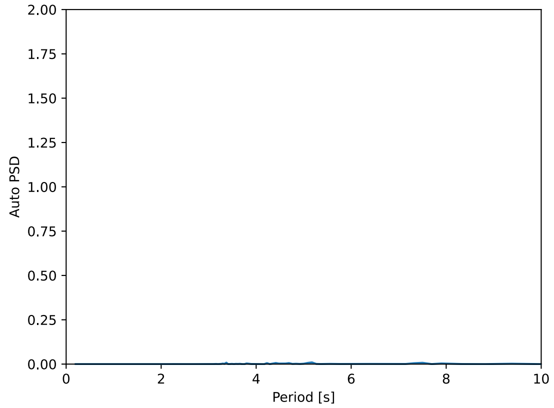
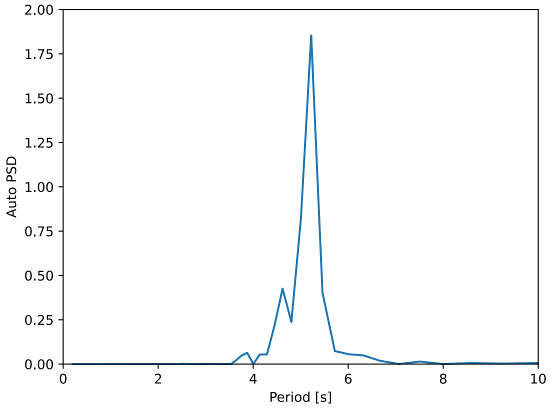
Splashzone spectral data – jacket roll

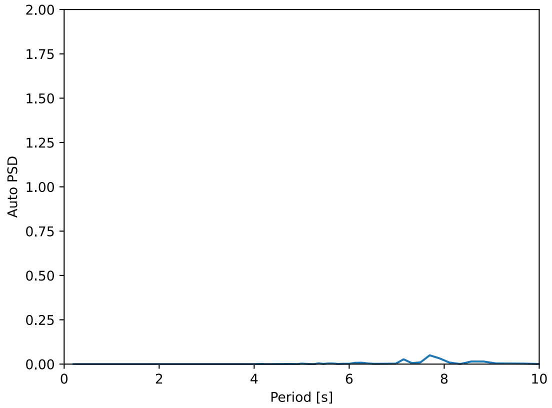
"In air"

Mudmats through splashzone

Jacket lowering continues







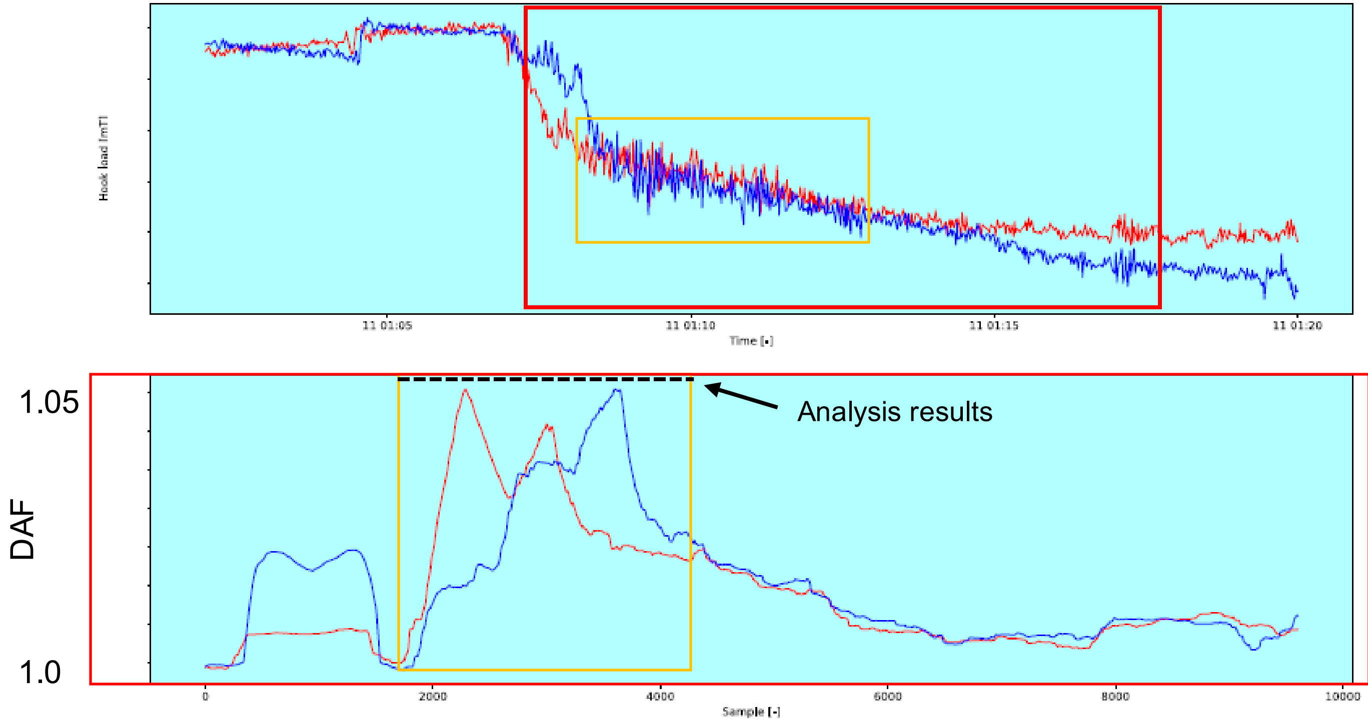
Power at higher periods > 10 s

Power at higher periods > 10 s

Hookload data

- Running average hookload dynamics (2 minute mean)
- Hoistwire dynamics clearly increase
- Hoistwire dynamics are still low

- Good alignment with analysis results



Thank you!

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